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The Electrical World's Digest of Current Literature.

WE begin in the present issue the new department which we referred to editorially last week, the object of which will be to enable the busy man to readily keep abreast with the current technical literature on electrical subjects published in the leading English, French and German electrical journals. This department will contain a classified digest of the most important technical articles published in these journals and will therefore enable our readers to obtain the essence of the voluminous literature without the expenditure of the time required to read over quantities of matter in order to find that which interests him in particular. The large amount of good matter published makes the need of some such summary imperative, and we trust that our readers will appreciate the large amount of work required to conduct such a department. For the present only the principal foreign periodicals will be included in this digest.

The Lamp Situation.

WE have watched with an interest akin to anxiety the development of the policy which the General Electric Company seems to have outlined for itself in the incandescent lamp matter. At the time of the decision of Judge Wallace there were few who believed that the consolidated interests would insist upon an extreme policy toward those outside, and the press as a unit discounted the supposition that its terms would be onerous. Those most seriously affected by the recent litigation, however, claim that the action of that organization of late has left no doubt of its intention of forcing to the wall its competitors in business, regardless of the effect on the industry at large. It was not believed at the start that the General Electric Company would care to face the popular indignation that would be aroused by such a course, and its best friends have counseled against it. The policy adopted is believed by many shrewd business men to be not only suicidal but also fatal to the best interests of the electrical industry. The attempt on the part of some of its licensees to restrict the sale of lamps to those using its own machinery has been met by the courts, it is true, but such relief is totally inadequate. It is well known that the General Electric Company has not the facilities to supply the total demand for incandescent lamps, and its present course, if continued, must result in paralysis of the business whose interests it should seek to protect. It is but fair to the General Electric Company, however, to state, as its officers have stated to us, that while they have no intention of being unfair or harsh with those who have infringed their patents, they have been compelled to adopt the methods pursued in order to establish their rights. When these are admitted and recognized the necessity for stringent measures will have passed, and those who are well disposed will be met half way in any proposition of a reasonable nature.

The Accuracy of the Drawings.

OUR artist had seen and sketched the principal electrical fountains of Europe as well as of America, and was doubtless as familiar with what had been done in this line as any one in this country, and, in addition, had had the assistance of Mr. Stieringer in getting at the plans of the new structures. As to the subject matter of the article accompanying the drawings, that was compiled from information given by the owners of the patents under which Mr. Stieringer is acting. Certainly information from this source seemed likely to be authentic, and it was given freely and without reserve. We may have been in error when, in describing some of the set pieces, we said that "the views as given were not ideal, but are exact representations of some of the set pieces as far as they have been decided upon by those in charge," for a person so original as Mr. Stieringer might discard all the pieces that have thus far proved successful and devise as many more that would excel them in beauty, but this would seem to be improbable. If such were his plan he may consider himself under obligations to us for pointing out what to omit. But our esteemed contemporary, conscious of its own virtue and the extent of its information, thought it well to include *one* fact in its kindly editorial criticism as a leaven to its other statements, and rises to "remark that the middle fountain of the three is *not* to have any electric light of its own." We congratulate it on this statement, even though it failed to credit us with having in substance said the same thing.

Enterprise vs. Bluster.

SOME one has epigrammatically defined a bore as a person who persists in talking about *himself* when you want to talk about *yourself*. THE ELECTRICAL WORLD in its issue of week before last published an elaborate article on the electrical fountains at the World's Columbian Exposition, with several handsome illustrations made by its own special artist from sketches taken on the ground and with the assistance of the working drawings. A week later one of its contemporaries had considerable fault to find with THE ELECTRICAL WORLD for printing the article. This contemporary, it seems, wanted to publish the article itself, and thought it had completed arrangements by which it should be the first to use it; but, lo and behold! along came THE ELECTRICAL WORLD, as it usually does, with the article ahead of everybody else. If our contemporary had kept still about it, and quietly nursed its chagrin, as it has had to do on many another similar occasion, few would have been any the wiser, but the disappointed editor cries "sour grapes," and says he did not want the matter anyway; that it was full of inaccuracies, and that the whole thing was exceedingly reprehensible generally. If, as claimed, our drawings of the fountain were incorrect, and the information given in connection therewith was erroneous, how, will our contemporary tell us, have we violated confidence, or wherein have we injured the interests about which they manifest such deep concern? The more they talk the more do they stultify themselves, for it is perfectly clear that they intended themselves to publish what they deprecate so loudly in us. That they attempted to bring to their assistance the talents of one of our regular staff is an acknowledgment of their own weakness that we are surprised they would be willing to admit. The fact of the matter is that THE ELECTRICAL WORLD has been and is doing splendid work in connection with the World's Fair, and our contemporary, failing in its efforts to handle this important matter in a similar manner, would belittle what we have done and are doing. The accusation that THE ELECTRICAL WORLD is in the habit of violating confidence by the publication of information intrusted to it, under injunctions of secrecy, is entirely untrue. Through personal friendships somebody will now and then furnish to another journal information to which we think the readers of THE ELECTRICAL WORLD are entitled. In such cases we try by every honorable means to prevent being distanced. As regards the Fountain article we violated no confidence, but the shrillness of the outcry shows where and how the shoe pinched.

Once There Was a Fox.

WHEN accused by an Eastern contemporary of alleged betrayal of confidence in the fountain article, we are reminded of the story of the thief who sought to escape the pursuing crowd by joining himself in the cry of "stop thief." That journal, as well as another published in a Western city, recently came out with a diagram of the assignments as determined upon in the Electrical Building. We are informed, reliably, we think, that this was a direct breach of confidence on the part of somebody, and that it has greatly displeased the authorities at Jackson Park. The news was stale, however, since many weeks before THE ELECTRICAL WORLD had published as much as the authorities were willing and ready to have made public. Our informant states that the matter will not be allowed to rest here, but that every effort will be made to run down the party guilty of making public what it was especially desired to keep *sub rosa* for the present. Our crime consists in having published matter which our accusers had hoped to publish themselves. With us it was a crime. With them it would have been a virtue. *O tempora! O mores!*

Proper Use of Terms.

WE often notice, especially in papers written by mechanical, civil and other engineers who are not electricians, that they use electrical terms incorrectly. We refer at present more particularly to the loose way in which the terms kilowatt and kilowatt-hour are used. A kilowatt is a unit of power or activity, and includes the element of time. On the other hand a kilowatt-hour is a unit of work or energy, and is as a unit entirely independent of the element of time; it is precisely like the terms foot-pounds, or horse-power hour, or joule, into which it is directly convertible.

The West Is Appreciative.

OUR article on the electric fountains at the World's Fair has attracted much wider attention than its author dared hope. Among the most appreciative of its readers were the editors of our esteemed contemporary *The Western Electrician*. Those gentlemen we have long known as public spirited citizens, proud of the fair fame of their beautiful city and appreciative of any reference to its varied industries. Detecting, as they thought, poetic allusion in our article to one of the principal of these, they have given it suitable prominence in their editorial columns and are undisguisedly pleased with the language in which it was couched. It is, therefore, with genuine sorrow and pain that we disabuse their minds of these pleasant thoughts by stating that our reference to *Pyg*-malion had no connection with an industry in which so much pride has been taken by the inhabitants of the Windy City.

The Canadian Electrical Association.

WE are pleased to call attention to the report of the convention, at Toronto, of our electrical cousins across the border, and to give, in abstract, most of the papers brought before it. As the direct offspring of our own National Electric Light Convention at Montreal, we feel something of a paternal interest in its growth and a pride in its success. For so young an organization it shows signs of extraordinary vigor, and the interest already attaching to its deliberations gives promise of a most brilliant future.

Electrical Oscillations of High Frequency.

THE work of Dr. Heinrich Hertz along the line of the investigation of electrical oscillations of high frequency has excited wide-spread interest, and the results obtained by this eminent physicist have been accepted everywhere as authoritative. The publication of this important matter, however, has been scattered over a period of some years, and it has been difficult for those interested in the subject to obtain the complete information and data. Elsewhere in this issue the first section of an interesting resumé by Mr. Ervin S. Ferry, of Cornell University, is given. After carefully reviewing the work that has been done on this subject, and pointing out how the numerous experiments may be performed, Mr. Ferry adds some suggestions deduced from his own experience during a recent series of investigations.

The Edison Lamp Patent.

Something of a sensation was created in electrical circles last week by the defense offered by the Beacon Vacuum Pump and Electrical Company, of Boston, in the suit of the General Electric Company. This suit was for a preliminary injunction to restrain that company from the manufacture and sale of incandescent electric lamps claimed to be an infringement of the broad patents awarded to Thos. A. Edison.

It will be remembered that in a similar suit against the United States Electric Light Company, Judge Wallace upheld the validity of the Edison patent of 1879, No. 223,898, and that since then an injunction had been granted against the Perkins Lamp Company, of Hartford, and restraining orders issued against the Sunbeam, the Illinois, and the Columbia companies—all manufacturers of and dealers in incandescent lamps alleged to be infringements of the second claim of patent 223,898 granted to Edison in 1879.

It will be noticed that in the case of the Perkins company alone has an injunction been granted, the temporary restraining order having been made permanent through a mistake, as claimed by that company. According to their statement Mr. Mitchel, counsel for the Perkins company, understood that the plaintiffs would not press the motion at the final trial, to convert the restraining order into an injunction, and was, therefore, not present to oppose the motion that was made. It is claimed by the defense that for this reason no adequate presentation of their defense was made, and that for this reason they were not surprised that the injunction was granted. Following this decision suits against the other companies mentioned rapidly followed, and in each case restraining orders were granted as already announced in these columns. The defense in no case was vigorous, and in each the order of the court was summary. The vigorous prosecution of alleged infringers thus commenced outlined in unmistakable manner the policy of the General Electric Company, and the proceedings against the Beacon Vacuum Pump and Electrical Company originally set for Monday, Jan. 16, seemed to be in the direct line of that policy, and attracted but little attention at the time. The fact that practically no defense had been made in the other cases and that in each restraining orders were at once granted led the electrical fraternity at large and others to expect the same result in this case as a matter of course.

The first indication that this latest suit was to be contested became apparent on Jan. 16, the day on which the trial was set, when Mr. Witter, of counsel for the defense, appeared before Judge Colt and obtained a continuance for one week on the plea of new evidence recently at hand which would materially modify the line of defense originally contemplated.

On Monday, Jan. 23, both parties to the suit appeared before Judge Colt in the United States District Court. The plaintiffs in the meantime having learned the nature of the new evidence asked for a continuance for one hour to enable them to examine the affidavits offered by the defense. This the court granted, and a recess was taken until noon.

In the afternoon the case was opened by Mr. Fish, followed by Mr. Dyer, of counsel for the plaintiff, on essentially the same lines pursued in the previous suits. Mr. Witter, of the firm of Witter & Kenyon, followed for the defense submitting a lengthy affidavit of Henry Goebel, which for the first time definitely indicated the line of defense to be followed, which had been more generally outlined in their answer by the plea of anticipation. This was followed by 27 other affidavits, and three exhibits all more or less corroboratory of that of Henry Goebel.

To those not parties to the suit and in a great measure also to the plaintiffs themselves, the affidavit of Henry Goebel came in the nature of a genuine surprise, and created a decided sensation in electrical circles as soon as it was known, for his testimony was no less than a claim that he himself had invented, used and repeatedly exhibited on the streets of New York previous to 1860 incandescent lamps answering in every respect, even to minute details, except shape of globes, the description of the Edison lamp of to-day.

THE AFFIDAVIT OF HENRY GOEBEL.

After stating that he was born in Germany and was now 74 years of age he proceeded as follows:

"I came to the United States in 1848 and settled in New York. My business in Germany was that of a watchmaker. I learned my trade at Springer in Germany. I formerly assisted Prof. Moenighausen in making experiments in physics, among them being the making of light by electricity. I also made many instruments for use by teachers. We made experiments in electric lamps. Besides understanding how to make an electric arc, I believed a practical and useful light could be made by a carbon in a small globe. We perfectly understood the use of the common exhaust air pump, the use of the blowpipe and the manner of producing a vacuum by the use of mercury. We were frequently engaged in this kind of work. While I was still at Springer, before I came to the United States, in 1848, we used anthracite coal for producing a light. The capacity for producing light by carbon is accomplished by being placed in a vacuum. We thus learned that this material was a suitable conductor. I also learned how to burn carbons by burning the wood inside the ferule of a broken walking-stick. This suggested to my mind how wood could be carbonised. I found that carbonised wood was a good conductor. I also made a magnetic machine for generating current. I used carbon for producing electric arcs. I found that incandescence could be produced by passing a current through a carbon after being placed in a vacuum. Professor Moenighausen had told me that these carbons when placed in a chamber from which the oxygen had been removed would burn steadily. At this time I became familiar with the fact that the coefficients of expansion of platinum and glass were the same.

"I studied chemistry off and on for ten or twelve years. My father was a manufacturer of chocolate. I became familiar with persons moving in the higher ranks of society. I left Germany in 1848 and reached New York in 1849. First I lived at 391 Monroe street, then at 271 same street, next at 500½ Grand street, then at 468 Grand street. My name is Heinrich Goebel. Immediately on my arrival in New York I began my business. I have had and still have a thorough knowledge of the art of watchmaking. I always had an inventive turn of mind and have always been busy trying to make inventions and improvements. As soon as I got over here I began to work at my electrical devices. I exhibited an arc lamp on the roof of my house and soon had a fire engine around to put out the supposed fire. Soon after this I turned my attention to glow lamps, or incandescent lamps as they are now called. In what I have done in that line I have always tried to carry out the idea of Professor Moenighausen, and used such material as I had in hand. The first incandescent lamp I made in the early fifties had its filament in the form of a fiddle bow or a meat-saw bow. These lamps are shown in the sketches herewith given. The metallic wires were directly fused into the glass, no cement being used in the lamps at all.

"The first lamps I made of this kind were made from cologne bottles and afterward I made them from tube glass. I was living at the time in Monroe street, New York. I left that street in 1872.

"The next form of lamp I made was the hairpin lamp, so called from the shape of the carbon, the leading-in wires being sometimes made of iron, platinum or copper. Sometimes I made them of other metals. As late as 1890 lamps with platinum leading-in wires were made. The glass cup or tube was thin, the air being exhausted by a blow-pipe. While working on this lamp I lived in Monroe street, where I made many similar ones.

"I made from time to time many more of the fiddle-bow type. After gas was laid through Monroe street some of the employees of the gas company would sometimes come in to see my lamps burning. These men became so suspicious that I was stealing their company's gas that they insisted on going down into my cellar to investigate. I would not show them my battery and its connection with the lamps.

"When I went out of business in 1890 my possessions got scattered and with them about all my lamps, some of which I now know are in existence somewhere. I sometimes made the platinum wires into curious shapes. I then moved into Grand street. No six months ever elapsed during which I did not make and exhibit some of my electrical devices. In 1881 I was sent for by some one connected with the American Electric Light Company and made them carbons for a long time. All the incandescent lamps I made were fitted with carbons which I made from vegetable material. The carbons had a diameter of about 1-100th of an inch, and whenever I increased the resistance I found I had not a sufficient number of cells of battery to supply current for them.

"The reason why these lamps never came into commercial use at that time was really because there was not, at that time, an adequate source of electricity, the battery being unreliable then as now. The conductors I made were carbonized in crucibles and I used flax, black cane, tampico, a species of grass, and other materials. I built a furnace wherein my carbons could be properly carbonized. I even tried to use the lead from lead pencils, but found it was too earthy. In those early days I used to attach the ends of the wires to the filament proper, twisting them together. To fasten the filament to the leading-in wires I used stove polish and found it to answer very well. My electrical current was produced by battery, and when in Monroe street I had a battery of 80 cells; it required so many to illuminate a single meat-saw lamp. From 1860 to 1880 I showed these lamps to my customers and friends. I gave away many of these lamps at different times. When I lived in Grand street in 1890, I had about twelve lamps. The lamps I exhibited in Monroe street attracted a large share of attention. I could make them very incandescent at times. When I found that a thick carbon was not so efficient as a thin one, I began to make the latter thin and with very gratifying results. About this time I built a large telescope and exhibited in Union Square and elsewhere. This was while I was living in Monroe street. When I got it where I wanted it to be, I made a small charge for looking through it. I had the telescope in a wagon and around the vehicle I hung a number of these lamps, current for which was supplied from a battery placed under the driver's seat. I sometimes took my son with me to assist me. One use of my lamp was to illuminate the face of a large case clock which stood in my own bedroom. I attached the wires to the mechanism of the clock, the circuit being made through the lamp. When the hours struck the current was turned on automatically, thus illuminating the face of the clock for a few moments. This was in practical operation for years. After removing from Grand street I fitted up another clock with a similar device. There was no time from 1861 to 1880 when I had not some lamps in hand to show my friends. I made no secret of their construction or any part of them. Prior to 1879 I made and used over one hundred lamps. I removed from Grand street in 1879. I made lamps of various sizes and gave them away to my friends. I never heard of a dynamo machine for lighting until I worked for the American Electric Light Company in 1882. I never heard of Edison until 1881 or 1882. I had to buy all the materials for my battery and lamps, which made it expensive for me. I did not hear or know that anybody had made or used an incandescent lamp. About that time I first heard of a dynamo machine for lighting purposes.

"I had never read in the newspapers, for I cannot read. Until my engagement with the American Electric Light Company, I knew very little of what was doing. I never saw Edison; in fact, never knew his name. About the year I came to this country I made a vacuum pump which I have used from time to time. It was with some considerable difficulty I got this mercurial pump applicable for my lamps. When I heard of the Geisler pump I made one and was successful in exhausting my lamps; I then made a larger sized one. This was in June, 1882. I afterward met Mr. Crosby; he was much interested in my lamps. I gave him some of them to try. He wanted me to go into the employ of his company. He allowed my son Adolph to work for them. He pressed me to make their carbons and I did so in my own workshop. For more than a year I made lamps of various kinds. The company furnished me with men to do the work while I attended to my own business. I recognize the Goebel lamps numbered 1, 2 and 3. They were made by me in Monroe street. I laid the gas into my house in that street, and immediately after I fitted up an apparatus for using my blow-pipe. I used a double blow-pipe. I tried to work cologne bottles, but they did not do; the glass was very brittle.

"Prior to 1867 I invented a hemmer and attachment. This was appropriated by the Singer Company without any profit to myself."

THE AFFIDAVIT OF JOHN C. GOEBEL.

Mr. Witter then read the affidavit of John C. Goebel, which stated that he is the eldest son of Henry Goebel and is an engineer by trade, having learned the mechinist's trade from his father. He distinctly remembered the electric lamps that the latter had made and used in large quantities, and had himself often lighted and tended the same. Recalled the shooting of one Key by another, Sickles, which occurred on Feb. 27, 1859, in his father's shop under the light of one of his father's incandescent lamps which stood on the show case at the time. The occurrence was also illustrated at the time in an illustrated paper of the day, which also pictured the lamps as he now recalled them. The lamps presented, exhibits 1, 2 and 3, he identified as exactly like his father's lamps as made at that time. In describing these he said, "some of these had burners shaped like a fiddle-bow, others like a hairpin and still others had the filament coiled in a spiral." The filaments in all cases were as small in cross section as the carbons of the lamps shown. He remembered distinctly having seen his father make the spiral carbons by winding a very thin splinter of wood around a cylinder, packing it in a crucible and putting the latter in the fire. He remembered his father having been accused of having made a "thief" connection with the gas mains, by the employees of the gas company, who, seeing the electric lamps in his shop assumed that they were gas flames. He positively stated that the filaments used were always of carbon and called "coke" by his father, and that they were carbonized in a black lead crucible placed in the range in the basement. The character of the crucible was definitely fixed in his mind because of the fact that from the name, he had assumed that they were made of metallic lead, and being of this easily fusible metal it had been a surprise to him at the time that they did not melt. The wires passing through the glass were usually of platinum, chips and chippings of that metal being bought for that purpose. Sometimes, however, other metals were used instead of platinum. Could not remember how the air was removed from the lamps, but does distinctly remember that his father repeatedly said that they contained no air, and recalled the difficulty he experienced in the conception of a space with nothing in it. He remembered his father's large telescope and stated that he sometimes exhibited it himself. When exhibited on the streets there were usually three of the incandescent lamps on the telescope wagon. One lamp, perhaps two, would burn while the wagon was going from Monroe street to Union Square. Some of the lamps were destroyed the moment the current was turned on, but most of them were used repeatedly without apparent injury.

After stating that he is a son of Henry Goebel, the affiant says that he has read his affidavit and remembers each of the three kinds of lamps mentioned therein, and had seen them all burning—especially did he remember the meat saw and hairpin lamps, and that as they burned on the counter in his father's store where all could see them, they attracted a great deal of attention. When quite young, he usually accompanied his father when exhibiting the telescope in Union Square and elsewhere, and remembers that the meat saw and hairpin lamps were at such times frequently used, partly for the light they afforded and partly for the purpose of arresting the attention of passers-by. Identified the lamp shown him (exhibits 1, 2 and 3) as some of those made by his father previous to 1872. They did not burn long at a time—usually not longer than half an hour, but this was because the batteries failed. Remembered being thrashed by his father for breaking a meat saw lamp. This was on the day that he saw his brother off, who had enlisted in the navy during the war of the Rebellion. He further corroborated his father's and his brother's testimony in regard to the construction of the lamp, in that the latter was wholly of glass—that the leading-in wires were fused into the glass, and that the carbon filament was usually attached to their inner terminals by means of a cement of stove blacking. He further testified that his father had connected one of the lamps to a clock in such a manner that when the latter struck the hours, its mechanism connected the lamp in an electric circuit and illuminated its dial and cut it out again when the hour had been struck. This clock arrangement was in operation both before and after the year 1872. In 1878 or '79 his father made and used a mercury vacuum pump in exhausting the lamps.

Horace E. Van Raust followed with an affidavit stating that he had been on the New York police force for the past 32 years. Knew Henry Goebel from about 1863 to 1872. Knew him as a watchmaker and optician, and had frequently been in his shop. Remembered the telescope mounted on the wagon and that very brilliant lamps were employed to attract attention. He remembered also that Henry Goebel exhibited these same lamps in his store—that the luminous part was inclosed in glass, and that Goebel said the light was due to electricity, but did not remember having seen any batteries. Many people besides himself had seen these lamps, and they were considered at the time very remarkable. Goeble was a good-natured, reliable man, always experimenting, and on one occasion had electroplated the buttons of his police uniform. He believed him to be a responsible man, and one whose word could be relied upon.

Mr. Crossley's affidavit was then read, in which he detailed the manner of making the acquaintance of Henry Goebel; he first heard of the latter in 1880, and found him in his workshop in Grand street. Goebel told him that such lamps as he was then making he had made for years past; he gave Crossley some of his carbons to take away with him, and, subsequently, his company em-

ployed him to make carbons for them. His carbons were of very high resistance. Goebel's carbons proved to be very superior to the American company's carbons. Mr. Crossley stated that Goebel's knowledge of and familiarity with incandescent lamps greatly surprised him. As a former assistant of Mr. Edison at Menlo Park, Mr. Crossley claimed to know a great deal about such lamps.

Mr. Franklin L. Pope then followed. He stated that he had examined the three exhibit lamps that had been made by Goebel, and that none of them were now in condition to be operated, though he was entirely satisfied that when first made they were capable of such operation, and that they had been so operated. He then went on with a detailed description of the lamp, calling attention to the fact that the leading-in wires were fused into the glass and that the light-giving portion of the filament in exhibit No. 3 was 1 1-16 inches long and from eight to ten one thousandths of an inch thick, that it was composed of carbonized woody fibres of endogenous growth, probably bamboo; the chamber was now cracked and there was therefore no vacuum in it, but that there had been a vacuum in it is proved by the indentations at the top made by the pressure of the air when the glass was soft, and by the smoky discoloration on the inside of the glass which could only have been made by the vaporization of the carbon when in a state of incandescence.

Deponent was clearly of the opinion that these structures embodied the invention of the second claim of the patent in suit, and that the making and using of them necessarily involved a knowledge of the fact that a filamentary carbon would withstand high incandescence when placed in a nearly perfect vacuum. He believed it entirely practicable to construct and operate such a lamp with the methods and appliances which Goebel states that he made use of. And that with equal care and skill in the manufacture they would have a life commensurate with lamps made in accordance with the instructions laid down in the patent in suit. He states that some of the first lamps made by Edison lasted but a short time, but the long duration of others demonstrated the correctness of the principle, and has been more uniformly attained only by careful attention to all the details of manufacture.

Nicholas Finck deposed that he lives in Elizabeth, N. J., and keeps a jewelry store, has known Goebel for many years, having made his acquaintance first in 1853, and was frequently in his store, has often seen such lamps as those exhibited in Goebel's possession, and burning in his shop, is positive that he saw such lamps before he left New York in 1855 and also since. Had frequently seen these lamps in process of manufacture, and described the same somewhat in detail; remembers having seen Goebel split up pieces of bamboo no thicker than fine wire or fine silk thread, saw these thin pieces of bamboo both before and after they were carbonized, but did not remember how the wires and carbons were fastened together; was interested with Goebel for eight or ten years in trying to make something out of a patent for a hammar, which was finally granted in 1865; this business led to his frequently seeing him in his place in New York; was sure that from first to last he saw four or five different lamps before he left New York; the shape of the carbons was sometimes straight and sometimes bent like a hairpin; he regarded Goebel as a very ingenious man, and stated that he made his own batteries and his own tubes, and carbonized the filaments and made the connections himself; had no doubt that Jacob Fey would remember the lamps, as he was much about Goebel's store, his statements could be relied upon.

Jacob Fey, of Brooklyn, made affidavit that he was a native of Germany, a mason by trade, and came to New York in 1847; first knew Goebel in 1849; was often in his store on Monroe street, and distinctly remembers the small glass lamps which Goebel made and used, in fact, had himself helped to make some of them—as many as 50, at least—some of these he assisted in making in 1852, and many more after he returned from Philadelphia in 1857. Had seen such lamps burning in Goebel's store hundreds of times. He had also helped Goebel to exhibit his big telescope, once on Chatham Square, and had often seen the lamps burning on the wagon when the telescope was exhibited; further, he identified the lamps shown as precisely like those he helped to make. In regard to the vacuum, he stated that he had assisted Goebel in creating it, and described the method employed, which was by the means of a quicksilver pump.

Celestine West, a daughter of Henry Goebel, corroborated in many particulars the statements made in her father's affidavit, as did also Mrs. Nicholas Finck, who fixed the date at which she saw the lamps in operation by the birth of her first child, which occurred in 1860.

In addition to the above, many other affidavits were produced from old residents of New York, who had known Goebel from 30 to 40 years, and who affirmed that they frequently saw his lamps burning both in his store and on the wagon.

Prof. Elihu Thomson testified that he remembers the incidents attending the formation of the American Electric Light Manufacturing Company, and other concerns; heard of Henry Goebel being engaged to make carbons for the American Electric company, but did not think there was much in the story of Goebel's inventions; in 1881 he visited Goebel's workshop and saw what was being done, but could not be induced to believe in the commercial value of Goebel's inventions. The lamps he had examined did not contain a vacuum, and so could not be successfully used.

The affidavit of John P. Randall, lamp expert for the General Electric Company, also that of Mr. J. W. Howell, indorsed Prof. Thomson's opinion as to the value of Goebel's lamp. Prof. Charles R. Cross, of the Massachusetts Institute of Technology, deposed as to the character of Goebel's lamps, pointing out their prominent features and enumerating the usefulness and value of such an early invention. The evidence of Leonard E. Curtis, one of the counsel for the Edison company, in its suit against the United States company, showed that he was familiar with Goebel's work in 1882, at which time the inventor called at his office and related that he had been making lamps since 1850; as Goebel could speak very little English, Curtis had difficulty in getting anything like a connected story from him. From all that he got, it appeared as if he had never done any commercial work of value with his lamp, so no further thought was given to the subject. From 1882 to 1890 Curtis heard nothing further of Goebel; it was during the trial of the case against the Sawyer-Man company, in 1892, that Curtis heard these affidavits about Goebel's telescope and electric lamps which illuminated the wagon on which it was mounted; it was not thought that such evidence was worth anything to his clients, and for this reason he did not look it up.

The nature of the arguments was pretty thoroughly determined by the character of the evidence, a brief outline which has been given above; the prosecution endeavoring to show that the Goebel affidavits were not new, that all of this evidence had been at hand to the previous defendants, and that both they and the plaintiffs had regarded it of so little importance as not to justify either of them giving it attention; they also claimed that the truth of this testimony had not been established, dwelt upon the unreliability of any evidence that depended upon memory of any event or circumstance having occurred 30 or more years ago. They also maintained that even were the testimony admitted to be true, that it was not sufficiently specific to establish beyond question that Goebel ever had anticipated the vital points of the Edison patent. They maintained that Edison had established a new art, but that Goebel had not; the evidence of this, being the fact that the Goebel lamp never came into practical use, nor did its invention add anything new to the sum total of our knowledge. They dwelt on the fact, as claimed by them, that Goebel was merely an experimenter, jumping from one idea to another, doing a little here and a little there, but finishing nothing; they claimed that the defendants' best testimony did not even demonstrate that Goebel's lamp was a practical one, or that its life was longer than that of other lamps made either before or after by other experimenters; nor would they admit that there was any proof to show that Goebel had employed a filament as defined in Judge Wallace's decision, or that it had been inclosed in a glass vessel in which a vacuum had been created. The defense, of course, laid great stress upon the unimpeachability of the testimony offered, and endeavored to explain away the fact that neither Goebel nor his friends had ever applied for a patent on an invention the importance of which all must have known along toward 1879, when the papers and the public in general were greatly excited over the experiments and claims of Edison. Mr. Witter's argument in behalf of the defense was exceedingly strong, and attracted the attention of every one present. At the close of the arguments on Wednesday afternoon, after an appeal from the plaintiffs for the granting of an immediate restraining order by the Judge, and a request for additional time on the part of the defendants, in which to prepare in proper shape their arguments, the Judge declined to interfere for the present, and gave both parties one week in which to hand to him in print their arguments.

EXHIBIT 1.

EXHIBIT 2.

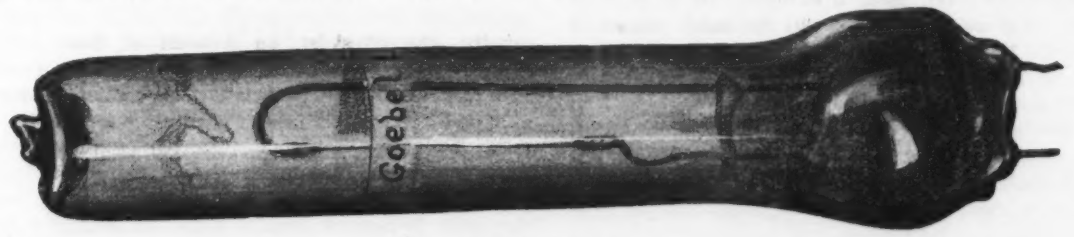

EXHIBIT 3.

THE EXHIBITS.

The main exhibits presented by the defendants, on which they greatly relied, were three lamps alleged to have been made by Henry Goebel, previous to the Edison patent; these were numbered 1, 2 and 3, and are illustrated herewith in full size. All three belong to the type referred to as the "meat saw" lamp, and consist of glass tubes about one inch in diameter, sealed at both ends. Through one end passed the leading-in wires, which, in the case of Exhibits 1 and 2, are of iron, and in Exhibit 3, of copper; these are sealed into the glass, which was evidently softened by heat and then clamped down firmly, while in a plastic state, by means of pincers. In Nos. 1 and 2 the end of the tube opposite the seal has been drawn out to a point, very much in the manner in which the globes of the present day are drawn out. The exhaustion of the tube was probably effected through this end after the introduction and the sealing in of the leading-in wires and filament at the other end. Exhibit 3 is more bunglingly sealed at this end, as illustrated in the cut. In exhibit 1 the leading-in wires inside of the seal are strengthened and supported by a piece of glass clamped on to the wires, as shown. In Exhibits 2 and 3 there are two of these supports. All of these lamps are cracked or broken in some of their parts, so as to admit air and destroy the vacuum which it is claimed was originally produced within. In the case of Nos. 2 and 3, the carbon filament has become separated at both ends from the leading-in wires, and lies loosely in the bulb. In Exhibit 3, however, the filament remains intact, showing both the manner of attachment to the leading-in wires, and, as far as outward appearance goes, a complete lamp. To prevent the dropping out of the loose filament in bulbs 1 and 2, drops of sealing wax have been placed over the holes referred to. In the case of No. 1, the sealing wax is placed at the terminal of the narrow seal, which has evidently been broken off at this point. In the case of No. 2, the break occurred at the point where the leading-in wires are sealed in, and a drop of wax has been placed on each side of this seal. This wax is said to have been placed there by Mr. Bull, of the firm of Broadnax & Bull, for the purpose specified. The blackening of the interior of the globe referred to in the testimony as evidence that the filament had been in a state of incandescence, is quite marked in No. 2; there is also a slight darkening in the upper end of Fig. 1. In No. 3 there is no evidence of this smoking, but in its stead there is a distinct yellowish tinge near the upper end of the bulb. In all three cases, the portions of the lamps which had been softened to enable them to be sealed have been considerably darkened. But this is probably due to a reduction of the oxide of lead which is a component part of some of the softer grades of glass, caused by the reducing action of the flame to which they are subjected in the softening process. The filaments in all three cases are exceedingly fine, and would seem to answer in every particular the requirements of the Edison patent.

COMMENTS.

While it is impossible to determine at this early day what the final decision will be, the fact remains that the extension of time granted by the court partakes of the nature of a triumph for the outside lamp manufacturers, and will have an important influence upon the lamp market. The existing state of affairs may be briefly stated as follows: Most, if not all, of the alleged infringers of the Edison patent, have contracts ahead

which they feel bound and are anxious to fill; many of them also have considerable stocks on hand, and among these stocks are comprised large numbers of lamps which were made before the plan of blowing the lamps into molds was adopted. Such lamps, while equal in other respects to those blown into molds, lack the uniformity in size and shape, and for this reason have been considered somewhat off color and not readily salable. Those companies which have already been enjoined, or against whom restraining orders have been granted, no longer able to fulfill their standing orders, are turning the same over to the other companies against whom action has not been brought, and the latter are filling the same not only with the accumulated stocks of their former competitors, but also with lamps of their own manufacture, and with such as before had but little market value. It seems probable that no decision can be reached for some weeks to come, and in the mean time the alleged infringers will have ample opportunity of unloading their accumulated stocks and, it is feared, to the injury of the lamp business.

The so-called new evidence, which has been brought forward in the present suit, has caused all minds to revert to the Drawbaugh case in connection with the Bell telephone litigation. The latter, however, is not especially a parallel case, for it was proved that Drawbaugh was an imitator, a charlatan, and a man without character, and that he was induced to offer his testimony by a company organized for the purpose of defeating the Bell patents. The Drawbaugh claims, too, were made early in the history of the telephone business at a time when the telephone had not assumed an importance recognized by the people at large. It had not then become the necessity that it is now, and there were at the time numerous conflicting claims not yet fully adjudicated. In the present case it will be necessary to prove beyond peradventure that Goebel did construct, use and exhibit lamps of the character which he claims to have made, used and exhibited, at a time previous to the application of Edison for patents, which the Beacon company have been accused of infringing. It must be proved that Goebel did add to our knowledge something material in the art, in other words, that he did make and use a practical lamp, answering the description claimed in the Edison patent. The difficulty of accomplishing all this in the face of the decision already obtained in favor of Edison, by means of testimony in regard to minutiae and details dependent solely upon memory, extending over more than 30 years, will at once be apparent to all. Another great difficulty which the defendants must meet, is to satisfactorily explain how it was possible that Goebel could have remained in ignorance of Edison's work at a time when it was attracting the attention of the whole world, that, notwithstanding the fact that he was early employed in the manufacture of lamps under the Edison patent, that neither he nor his friends ever made the claim of priority of invention or applied for patents governing the same. One of the points relied upon by the prosecution for overthrowing the claims of Goebel, is that granting that the latter constructed and used such a lamp as claimed at the time claimed, still that it was not a practical lamp, because of the admitted testimony that it burned for a few hours only. It seems to us that the question should rather resolve itself into this: Did Goebel construct a lamp which would be a practical one at the present day; the admission that his lamps would burn but a few hours consecutively at most, is explained by the defendant on the ground that the dynamo had not then been invented, and that the trouble was in the failure of the source of electricity, and not in the lamp. Granted that there were constant primary batteries at that day, it would seem that Goebel's claims should not be vitiated simply by the fact that he either did not know of these constant batteries, or did not use them. The question of supply of current is not at issue in this case, and it would seem that objections based upon inadequate or inconstant supply, are not well taken, for by the same course of reasoning the Edison lamp of the present day would also be declared impracticable under the conditions under which the Goebel lamps were operated.

While the excitement over the present situation in the West is intense, and considerable confidence is felt that the decision will be unfavorable to the prosecution, we find it attracts very much less attention in New York, and still less in Boston. Throughout the argument many attorneys were present from various parts of the country, who watched with the deepest interest the progress of the case and its result as bearing upon the outcome of probable future action of a similar nature against their clients. Among these the feeling was unmistakably one of lack of hope. Another indication of the general feeling among those who are posted, is the condition of the stock market, which is a most sensitive indicator of the public pulse. Did Wall street feel confident of the failure of the prosecution to make their case a flurry in the electrical stocks would be inevitable. On the contrary, we find them remaining firm, with but a very slight drop, which has been attributed by financiers to other agencies.

On the other hand, many of those who are behind the scenes feel that the present defense, strong as it is in many respects, may be materially strengthened by evidence at hand and to be procured, not yet presented, and while they will not assert an abiding confidence in the defeat of the General Electric Company in the present instance, do believe that their course has been checked and that eventually the patent will be overthrown.

Concerning the Latest Claimant.

BY PARK BENJAMIN.

What a strange and topsy-turvy sort of a world this is, and what lots of surprises must still be in store for us. Who would ever have imagined Franklin Leonard Pope and Charles R. Cross appearing as the converts and advocates, not merely of a claimant, but of the most exaggerated of all the claimants who have yet turned up. Carry the news to Drawbaugh!

And just consider for a moment Drawbaugh beside Goebel. And observe how Goebel's strictly fin de siecle story improves on his. Daniel claimed that he made telephones as early as 1867, and had kept on making them up to 1879, when the suit was started. He produced a lot of them, and they worked. Pope said so. Cross likewise. He proved that he had had no money, no rich friends, that his relatives laughed at him and his only assistant was his little daughter—one of that proverbially large family which the inventor always has; that he had exhibited and used his instruments only in a little out-of-the-way village (originally a Hessian colony) in Pennsylvania. He, too, had not applied for any patent for want of money. And as the telephone, when the suit begun, had been in use barely a year, and even then the Bell company and the Western Union company were at one another's throats over it, there was mighty little information to be got which would enable any one to recognize in it the great public necessity that it afterward became. Nevertheless, Messrs. Pope and Cross (then experts for Bell) found Drawbaugh's story inherently and utterly incredible, and scouted it.

But here is a man who makes, not telephones, the insides of which people cannot see, and the working of which most people even now do not understand, but blazing electric lights for the express purpose of attracting public attention; who exhibits them, not in his shop in an obscure settlement and chiefly to ignorant villagers, and even then under the ban of ridicule, but constantly, night after night, on the greatest square in the greatest city of the United States; who advances his claims, not at the very outset of litigation, upon a device barely in public use and upon a patent so doubtful in its terms that it has never been and never will be undisputed, but at the virtual end of one of the most elaborate and lengthy patent proceedings ever had in this country, and the one in which, of all others, the public has been most directly interested. And then claims that he made the apparatus more than thirty years ago, and, in fact, at such a distant time that the whole Drawbaugh episode, from Drawbaugh's very earliest alleged date of conception, down to the final decision in the Supreme Court, is included within and does not cover much more than one-half that period.

Perhaps he did. And, if so, every one will agree in recognizing the occurrence as the most phenomenal that has ever happened in the whole history of invention. But pending its complete demonstration, it may be well to warn the electrical community in general against mistakes regarding their whilom models of conservative opinion, Messrs. Pope and Cross, as having in the past sturdily rejected the gnat, only to acquire strength for a subsequent complacent swallowing of the camel.

Electrical Oscillation of High Frequency.—I.

BY ERVIN S. FERRY.

Since the first publication, five years ago, of the epoch-making inventions of Dr. Heinrich Hertz, physicists and electricians all over the world have been repeating and amplifying these experiments with great pains and ingenuity—the physicist, on account of their important theoretical bearing in the electromagnetic theory of light, and their adaptability for use in determining certain constants, while the electrical engineer has been chiefly interested in their bearing on the questions of obtaining efficient illumination, and telegraphy without wires. It is the object of this paper to bring together the most important results thus far obtained by the various investigators and to note, without the use of mathematical subtleties, the methods by which they were derived.

For the convenience of the reader, who may wish a more extended treatment of the subject, copious references will be given in the text. For simplicity, all reference to Hertz will be made to the page of his recently published book, containing his collected articles, entitled "Untersuchung ueber die Ausbreitung der Electrischen Kraft," and similarly to H. Poincare's "Electricite et Optique," instead of the original articles.

PRELIMINARY EXPERIMENTS.

Connect the secondary of an induction coil with two discharge terminals A and B, as shown in Fig. 1. A piece of wire about four metres long, terminated by two small spheres, C and D, is bent into a rectangular and connected to one pole of the discharge. A micrometer screw can be connected to these spheres, so that the length of the spark or the relative difference of potential of the terminals at different times may be measured.

Suppose, now, the coil is put into action, then the terminals A and B are charged with potentials of opposite sign, and if this potential difference is sufficient to spark across A B, the spheres will be discharged. And, if the values of the resistance R, the self-induction L, and the capacity C, satisfy the inequality

$$R < \frac{4L}{c}$$

this discharge is oscillatory. In this case sparks will flow between C and D, even though they are separated several millimetres.

This may be explained by the superposition of the disturbance incident at C upon that reflected from D. If a company of soldiers take one step on a bridge, a vibratory motion will be started, which will proceed to a pier, and then be reflected back. If another step be taken, just as this one reached the company, a stronger vibration will be sent through the bridge; and if the interval between the treads of the marching company be of this period, the vibration will soon become so intense that the bridge will break. Similarly with the preceding experiment, if the length of the wire in the rectangle is properly taken with reference to the period of oscillation of the disturbance from the induction coil, the disturbance at C will proceed to D, be reflected back, and another superimposed upon it when it reaches its origin, and this repeated till the oscillation is strong enough to break across the air gap in the form of sparks. From its similarity to an analogous phenomenon in acoustics, this action has been called "electrical resonance," and the micrometer circuit is usually spoken of as an electrical resonator.

The resistance of the micrometer circuit exerts very slight influence upon the sparks. However, if the

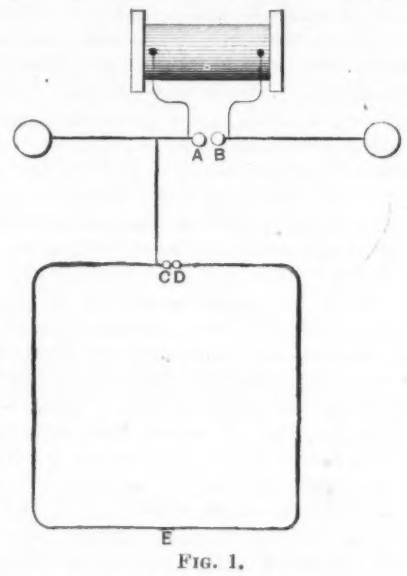

Fig. 1.

capacity or self-induction of the circuit be altered, the sparking distance is correspondingly changed. This agrees with all previous observations that the rate of propagation of electrical disturbances is nearly independent of the resistance, but depends upon the capacity and self-induction. Also, if the point of contact between the micrometer circuit and induction coil is changed, the sparking distance is altered. As this point is moved along the circuit toward the axis of symmetry passing through the air-gap, the sparking distance gradually decreases till it reaches a minimum at the point diametrically opposite the spark-gap. Passing this point, as the contact is moved toward the other terminal, the sparks increase in length till they reach their original value at the corresponding position on the side of D. When the point of contact is at the place of no sparking, if the capacity or self-induction of one-half the circuit be altered, sparking will occur, while if simply the resistance of one side be changed, the equilibrium will remain unaltered. It is obvious that a change of the capacity cannot affect the time necessary for the oscillation to reach the terminals, and hence the phenomenon cannot be accounted for by single waves, but can only be explained by the principle of a standing wave, produced by reflection as above illustrated.

To obtain the effects desired, Hertz used an induction coil 52 centimetres long and 20 centimetres in diameter, excited by six large battery cells. He found that the primary spark must be sudden and disruptive. The terminals must not have points or roughnesses, as in this case the charge would be gradually dissipated and produce no sharp and well defined oscillation. The rule he gives us is to polish the brass spheres till we can see our own reflection in them. One great difficulty is to preserve this polish. The spheres must be polished as often as twice per hour when in use. This trouble can be, to a large extent, obviated by plating them with some non-corrodable metal, such as gold or platinum. The spark must also be carefully adjusted. One about three-fourths of a centimetre in length, that is of a brilliant white color, somewhat zig-zag in shape, and emitting a sharp noise, is found by experiment to give the best results. After a little practice, one can judge by the noise of the stream of sparks if they are of the proper kind to give the greatest effect.

(To be Continued.)

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Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.

RAGO (Dominique Francois Jean), famous French astronomer, physicist and statesman (1736–1853), who at the early age of twenty-three had, besides being assistant astronomer to the Observatory, become the successor of both Lalande in the Academy of Sciences and of Monge in the chair of analytical mathematics at the Polytechnic School, and who, conjointly with Gay-Lussac, had founded the highly valued *Annales de Chimie et de Physique* in 1816, communicates to the French Institute, on the 25th of September, 1820, his discovery that the electric current has the power of developing magnetism in iron and steel. He constructed a galvanic conductor in the form of a coil, or helix, into the axis of which he placed a needle, the extremities of the wire coil being connected to the poles of a battery, and with this he proved that the wire not only acted on bodies already magnetized, but that it could develop magnetism in such as did not already possess the power. When soft iron was used, the magnetism given was only temporary, but on repeating the experiment with some modification, Mr. Arago succeeded completely in magnetizing small steel needles permanently. Arago's paper on the subject appears at page 94, vol. xv. of the *Ann. de Ch. et de Ph.*, and it is said that at about the same time Dr. Seebeck laid similar results before the Berlin Academy, and that Sir Humphry Davy also independently made a like discovery, of which he advised Dr. Wollaston Nov. 12, 1820. Reference to this fact has already been made at Davy, under date A. D. 1801, wherein it was stated that the latter had found iron filings to so adhere to the connecting wire as to form a mass 10 or 12 times the thickness of the wire. This was also the case in the experiments of Mr. Arago, who, upon observing that the filings began to rise before they came in contact with the conjugate wire, drew the conclusion that each small piece of iron was converted into a temporary magnet. It was through the above named observations that Mr. Arago was led to the important discovery of what is called magnetic induction by electric currents, or, in other words, that an electrical current passing through a conductor will induce magnetic action in such bodies near it as are capable of being magnetized.[1]

A fact worth noting in connection with the development of Oersted's discovery by both Arago and Ampère, is that in order "to prevent the communication of the electricity laterally in the folds of the coil the wire was insulated by varnish in the first instance, and afterward by winding silk or cotton around it."[2]

On the 22d of November, 1824, Mr. Arago announced to the French Academy of Sciences the remarkable discovery made by him of a new source of magnetism in rotatory motion. He was led to this by observing that when a magnetic needle was oscillating above or close by any body, such as water or a plate of metal, it gradually oscillated in arcs of less and less amplitude, as if it were standing in a resisting medium, and, besides, that the oscillations performed in a given time were the same in number.[3] He caused a circular plate of copper to revolve immediately beneath a magnetic needle or magnet, freely suspended in such manner that the latter might rotate in a plane parallel to that of the copper plate, and he found that the needle tends to follow the circumvolition of the plate; that it will deviate from its true direction, and that by increasing the velocity of the plate the deviation will increase till the needle passes the opposite point, when it will continue to revolve, and at last with such rapidity that the eye will be unable to distinguish it. This, says Mrs. Somerville, is quite independent of the motion of the air, since it is the same when a pane of glass is interposed between the magnet and the copper. When the magnet and the plate are at rest, not the smallest effect, attractive, repulsive, or of any kind, can be perceived between them. In describing this phenomenon Mr. Arago states that it takes place not only with metals, but with all substances, solids, liquids, and even gases, although the intensity depends upon the kind of substance in motion.

Arago's experiments were repeated in London, March 7, 1825. His valuable discovery, which obtained for him the Copley medal, and which confirms the doctrine of the universal prevalence of magnetism in all bodies, is recorded in Arago's "Sur les Déviations . . . aiguille aimantée,"[4] and a solution of the phenomena is given by Faraday in *Phil. Trans.* for 1832, p. 146, by Sir John Leslie in the Fifth Dissertation of the Eighth "Britannica," p. 746, as well as in the article "Magnetism" of the latter publication, and in Mrs. Somerville's "Conn. of Phys. Sc.," pp. 325–327.[5]

In Brewster's *Edinburgh Journal of Science* (vol. v., p. 325), notice is given of Mr. Arago's then recent researches on the influence which bodies considered not magnetic have on the motions of the magnetic needle, and reference is made to a new communication transmitted by Mr. Arago to the Académie des Sciences, as well as to a report of additional experiments in the same line given at meetings held July 3 and 10, 1826. Mr. Arago satisfactorily meets the denials made by Mr. Nobili and another Italian natural philosopher, that substances not metallic have any influence on the magnetic oscillations, and he announces that he has made investigations, from which it resulted that, for certain positions of a vertical needle, and for velocities of rotation sufficiently rapid, the repulsive force which is exerted in the direction of the radius is as great as the force perpendicular to the radius, the effects of which are observed upon a horizontal needle.

Mr. Poisson having stated, in his memoir "On the Theory of Magnetism" in motion[6] that Coulomb had recognized the magnetic virtue in all bodies, independently of the iron which they contain, Mr. Arago remarked that the idea of Coulomb was quite different from his, Coulomb having been of opinion that a quantity of iron too small for chemical analysis even to appreciate was yet sufficient to produce in bodies which contained it appreciable magnetic effects. MM. Thénard and La Place confirmed this remark, and Mr. Poisson said that he would suppress the assertion, which he had made without attaching to it any importance. Brewster adds that, in justice to Mr. Coulomb, it is necessary to remark that he is the undoubted author of the discovery that all bodies, whether organic or inorganic, are sensible to the influence of magnetism. Mr. Biot has remarked that there are two ways of explaining this, either all substances in nature are susceptible of magnetism, or they all contain portions of iron, or other magnetic metals, which communicate to them this property. This last explanation, though adopted by Coulomb, by no means affects his claim to the discovery of the general fact that all bodies, whether organic or inorganic, are susceptible of becoming magnetic. . . . Prof. Hansteen has drawn from

HANS CHRISTIAN OERSTED.

numerous experiments and observations the important conclusion that every vertical object, of whatever material it is composed, has a magnetic south pole above, and a north pole below.[7]

Mr. Arago made many valuable investigations concerning the influence of the aurora borealis on the needle, on the variations of the latter, upon the nature of meteors, lightning, the zodiacal light, magnetic storms, etc., etc., which are admirably recorded more particularly in the great work of Mr. De Humboldt. The latter remarks that this distinguished scientist has left behind him a treasury of magnetical observations (upward of 52,600 in number) carried on from 1818 to 1835, which have been carefully edited by Mr. Fedor Thoman, and published in the "Œuvres Complètes de François Arago" (vol. iv., p. 493). Much could have been said, especially regarding Arago's paper, presented by him to the Academy of Sciences in 1811, which is considered to have established the foundation of chromatic polarization. Passing mention can only be made, however, of the fact that in Mr. Humboldt's estimation the discovery of the two kinds of polarization of light may be considered the most brilliant of the century. They, unquestionably, rank among the most splendid of optical phenomena. Malus, a distinguished French philosopher (Fifth Dissert. of "Enc. Brit."), discovered in 1808 polarization by reflection from polished surfaces, and Arago, during 1811, made the discovery of colored polarization. A world of wonder, remarks Humboldt, composed of manifold modified waves of light having new properties was now revealed. A ray of light which reaches our eyes, after traversing millions of miles from the remotest regions of heaven, announces of itself in Arago's polariscope (consisting of a plate of quartz cut across the axis placed in one end of a tube, at the other end of which is a doubly refracting prism) whether it is reflected or refracted, whether it emanates from a solid or fluid, or gaseous body, even announcing the degree of its intensity.[8]

In 1818 Mr. Arago was elected a F. R. S., he became a member of the Royal Astronomical Society and also member of the Bureau des Longitudes in 1822, was made perpetual secretary of the Academy and director of the Paris Observatory eight years later, and received the Rumford medal in 1850. The Copley medal given him in 1825 had never before been conferred upon a Frenchman of science. It was upon his urgent request that the "Annuaire du Bureau des Longitudes" and "Les Comptes Rendus hebdomadaires" were commenced by the Academy, 1828–1835.[9]

A. D. 1820.——Oersted–Orsted (Hans Christian), native of Denmark (1777–1851), professor of natural philosophy and founder of the Polytechnic School in Copenhagen, makes known, through a small four page pamphlet, entitled "Experimenta circa (effectum) efficaciam conflictus electrici in acum magneticam," his great discovery of the intimate relation existing between electricity and magnetism. He thus lays the foundation of the science of electro-magnetism, which subsequently received such an impulse from Ampère and Faraday.

It is said that after taking his doctor's degree in 1799, he gave much attention to galvanism and that during the year 1800 he made important discoveries as to the action of acids during the production of galvanic electricity, he being one of the first to show the opposite conditions of the poles of the galvanic battery, and that acids and alkalies are produced in proportion as they neutralize each other. Upon his return from a trip to France and Germany, in 1801-3, he lectured upon electricity and the cognate sciences, publishing thereon a number of essays.[9] He revisited Germany in 1812, and, at the suggestion of Karsten Niebuhr, published in Berlin his work "Ansicht der Chemischen Naturgesetze." . . . (Inquiry into the identity of chemical and electric forces), a translation of which was made by Mr. P. Marcel T. de Serres under the title of "Recherches sur l'Identité. . . ."[3]

The last named appeared at Paris during 1813, and not during 1807, as stated at p. 41, vol. lvii., of the *Philosophical Magazine*.[4]

One of his biographers says that Oersted was lecturing one day to a class of advanced students, when it occurred to him, as a means of testing the soundness of the theory which he had long been meditating, to place a magnetic needle under the influence of a wire uniting the ends of a voltaic battery in a state of activity. "In galvanism," said he, "the force is more latent than in electricity and, still more so in magnetism than in galvanism; it is necessary therefore to try whether electricity, in its latent state, will not affect the magnetic needle." He tried the experiment upon the spot and found that the needle tended to turn at right angles to the wire, thus proving the existence of electro-magnetism, or the relation of electricity and magnetism as mutually productive of each other, and as evidences of a common source of power. Previous to this time the identity of magnetism and electricity had only been suspected. For several months Oersted prosecuted experiments on the subject, and in July, 1820, promulgated his discovery through the Latin pamphlet above alluded to, wherein he contends that there is always a magnetic circulation around the electric conductor, and that the electric current in accordance with a certain law always exercises determined and similar impressions on the direction of the magnetic needle, even when it does not pass through the needle but near it.[5]

For this discovery, which naturally excited the wonder of the entire scientific world, he received the Copley Medal of the English Royal Society, the Dannebrog order of knighthood and numerous testimonials from nearly every quarter of Europe. As observed by Mr. J. D. Forbes[6] "the *desideratum* of a clear expression of the manifest alliance between electricity and magnetism has been so long and so universally felt, that the discovery placed its author in the first rank of scientific men. . . . The prize of the

[1] *Phil. Trans.* for 1821, p. 9; Tilloch's *Jour. of Sci.*, vol. lvii., p. 42, 1821; Eighth "Britannica," vol. viii., p. 532 and vol. xiv., p. 640; Thomas Thomson, "Outline of the Sciences," p. 563.
[2] F. C. Bakewell "Elec. Sci.," London, 1853, p. 37.
[3] See Humboldt's "Cosmos," Magnetic Observations, 1825.
[4] *An. de Ch. et Ph.*, vol. xxxiii. and *Phil. Trans.*, p. 467, for 1825.
[5] See also the observations recorded in Humboldt's "Cosmos," 1849, vol. i., pp. 172, 173; in Dr. Thomson's "Outline of the Sciences," pp. 556–558; Fahie, 282, 283, 321; Dr. Whewell, vol. ii., pp. 254–256; Brewster's *Edinb. Jour. of Sci.*, 1826, vol. iii., p. 179.
[6] See Poisson, A. D. 1811.
[7] *Edinb. Phil. Journal* for January to April, 1821.
[8] Delambre, "Histoire de l'Astronomie," p. 652; Humboldt, "Cosmos," 1849, vol. i., p. 33, vol. ii., p. 715.
[9] See Poggendorff, vol. i., pp. 53, 54, and the several biographies named at p. 202, vol. i., of "Johnson's New Univ. Cycl.," 1877; J. A. Barral, "Œuvres de F. Arago," 1854-55; Faria De e Arago, "Breve compendio . . ." Lisbon, 1800; Arago's "Notices Scientifiques," "Catal. Sc. Papers Roy. Soc.," vol. i., pp. 83, 84; "Encycl. Metropol.," vol. iv. (Magnetism), pp. 6, 7; J. F. W. Herschel, "Nat. Phil.," 1855, pp. 117, 244, and his account of the repetition of Mr. Arago's experiments on rotatory magnetism in *Phil. Trans.* for 1825; Whewell, "Hist. Induc. Sci.," 1859, vol. ii., p. 22; Phil. Mag., vols. lix., p. 233, lvii., pp. 40-49, lviii., p. 50, lxi., p. 131; "Lib. Useful Knowledge" (Magnetism), p. 91; Noad, "Manual," pp. 204, 534; "Ann. of Sci. Disc.' for 1850, p. 124; Harris, "Rud. Magn.," Parts i., ii., pp. 58–61 and *Phil. Trans.* for 1831, Part i.; Prime's "Life of Morse," pp. 168, 265, 266; Gmelin's Chemistry, vol. i., p. 317; *Comptes Rendus* for 1836, vol. ii., p. 212; Dredge, "Electr. Illum.," vol. ii., p. 122; Sturgeon, "Scient. Res.," Bury, 1850, pp. 13, 37, 216, etc.; Appleton, "New Am. Cycl." vol. xi., p. 71; *Sci. Am. Suppl.*, No. 204, p. 3,254; *La Lumière Electrique* for Oct. 31, p. 202; "Reports of the Smithsonian Institution" for 1857, pp. 102, 107; for 1862, pp. 132-143, and p. 127 of last-named for Malus' discovery.
[1] Thomson's *Annals of Philosophy* for October, 1820, vol. xvi., first series, p. 273.
[2] These are to be found, more particularly, in J. H. Voight's *Magazin*, vol. iii., p. 412; Van Mons's *Journal*, No. iv., p. 68; the *Bulletin of the Société Philomathique*, No. lxvii., An xi., p. 128; A. F. Gehlen's *Neues Allgem. Journal d. Chemie*, vols. iii. for 1804, vi. for 1806, viii. for 1808; Schweigger's *Journal*, vol. xx.; *Phil. Mag.*, vol. xxiii., p. 129; the "Skand. Lit.-Selskabs Skrifter," vol. i.; "Oversight over det Kongl. . . . Forhandlinger," 1814-1815; "Nyt Biblioth. f. Physik, etc.," vol. ix., and in the *Journal de Physique* as well as in the *Journal du Galvanisme*.
[3] Fahie, "Hist. of Electric Telegr.," 1884, pp. 270–273.
[4] See Whewell, "Hist. of Induc. Sci.," 1859, vol. ii., p. 244. It paved the way for his subsequent identification of the forces of electricity, galvanism and magnetism.
Prof. W. B. Rogers remarks that attempts to discover this connection had been made with galvanic piles or batteries whose poles were not connected by conductors, under the expectation that these would show magnetical relations, although in such cases the electricity acumulated at the extremities was evidently stagnant. It was reserved for Oersted first to bring into prominent view the fact that it was not while the electricity was thus at rest, but while it was flowing through the wire connecting the two poles, that it exhibited magnetic action, and that a wire thus carrying a current, while it had the power of affecting a magnetic needle, was in turn susceptible of being acted on by a magnet; and this was the initial step in the science of electro-magnetism.
[5] See Fifth Dissertation of the "Britannica," pp. 739, 740, 745; also the Sixth Dissertation, vol. viii., of the eighth edition, pp. 531, 600, 601, and Shaffner, "Tel Manual," 1859, chap. viii., as well as the *Practical Mechanic*, Glasgow, 1842, vol. iii., p. 45.
[6] Sixth Disser. "Encycl. Brit.," vol. i.

French Institute, which had been awarded to Davy for his galvanic discoveries, was bestowed upon Oersted."

Oersted's experiments were repeated before the French Academy of Science, by Mr. De La Rive on Sept. 11, 1820, and, seven days later, as we shall see, Ampère makes known the law governing electro-magnetism.'

The many investigations subsequently carried on by Oersted in different branches of science are alluded to in the works named below. Perhaps the most interesting, outside of the ones already spoken of, are those attaching to thermo-electricity which he made in conjunction with Baron Fourier, and independently of Dr. Seebeck.[8]

The Economy of Incandescent Lamps

BY L. K. BÖHM.

The question as to what is the best economy for incandescent lamps has been, within the last few years, quite extensively ventilated. Capitalists, as a rule, inquired first about the life of the lamp, irrespective of its economy. The life of the lamp is, however, not the sole factor to be considered; the economy has to be brought into the calculation too, because there exist certain relations between the life of the lamp and its efficiency.

Practice has shown that central stations using lamps of high life yielded small returns in dividends, while stations with lamps of short life gave good returns for the investor, although the expense for new lamps was considerably larger in the second instance. There are certain reasons which explain this apparent contradiction. If the investor had to pay for lamps only, then the ideal lamp would be the one which lasts longest. The investor has, however, to pay for the whole equipment of the station and for running it, but principally for the power which has to be generated per lamp, or, more correctly, per candle power.

Before entering upon the subject a few explanatory remarks are necessary. The life of the lamp depends first on the degree of incandescence to which the filament is subjected while the lamp is burning. A lamp whose carbon is heated up by the current only to a dull red will last forever, technical deficiencies not considered. On the contrary a lamp may be overheated so as to emit an excess of light, but it will not last; it may be overheated so that it breaks within a few minutes Between these two extremes there is the commercial lamp which lasts on an average, as is generally accepted, about 600 hours. This number, viz., this life of the lamp, shall form the basis for the following calculations.

A 16-c. p. lamp with an average life of 600 hours consumes generally 100 volts and 0.5 ampère = 50 watts. $\frac{50\text{ w}}{16\text{ c.}}$ = 3.1 watts per candle. Another lamp of 25 c. p. may use 100 volts and 0.775 ampère. $= \frac{75.5\text{ w}}{25\text{ c.}} = 3.1$ watts per candle. This lamp will also last 600 hours, because the number of watts per candle used is the same as above. A third lamp of 16 c. p. may use 100 volts and 0.64 amèpre $= \frac{64\text{ w.}}{16\text{ c.}} = 4$ watts per candle. And a fourth lamp of 16 c. p. may consume 100 volts and 0.4 ampère $= \frac{40\text{ w.}}{16\text{ c.}} = 2.5$ watts per candle. Knowing that 746 watts constitute an electrical horse power, we can easily find in each instance the number of candles produced per electric horse power

$\frac{746}{3.1} = 240$ c.; and $\frac{240}{16} = 15$ lamps of 16 c. p. per elec. h. p.

$\frac{746}{4} = 186.5$ c.; and $\frac{186.5}{16} = 11.6$ lamps of 16 c.p. per elec. h.p.

$\frac{746}{2.5} = 208.4$ c.; and $\frac{208.4}{16} = 18.65$ lamps of 16 c.p. per elec h p.

It is plainly seen that with the same running expenses in the station per electrical horse power the efficiency and the number of lamps varies greatly. Unfortunately with the efficiency the life of the lamp changes.

A lamp consuming 3.1 watts per candle lasts about 600 hours; one consuming 4 watts per candle about 1,500 hours; one using 2.5 watts per candle about 300 hours; while a lamp made by the manufacturer to consume 5 watts per candle lasts practically forever. It cannot, however, be used forever, as it has to be exchanged at a certain time for a new lamp, because the globe blackens too much inside, in consequence of which less light is emitted. Furthermore, the resistance increases as the volatilization of the carbon goes on, less current will pass through and less light be produced.

Suppose now that each lamp costs 50 cents, then the expense for 16-c. p. lamps is:

(1.) For 600 hours, with lamps of 4 w. per candle. .20 cents
(2.) " " " " 3.1 " " ..50 "
(3.) " " " " 2.5 " " ..100 "

That is, per electrical h. p.

(1.) For 11.6 lamps (4 w. per c.), = $2.32
(2.) " 15 " (3.1 "), = 7.50
(3.) " 18.65 " (2.5 "), = 18.65

These figures are apparently in favor of long life lamps, but the returns collected will prove the contrary. Users of incandescent lights pay annually one cent per hour for the burning of one 16-c. p. lamp—that is, for 600 hours $6 for 16-c. p. lamps of any economy; but the number of lamps for electrical horse power has to be considered too.

(1.) At 4 w. per c., 11.6 lamps yield in 600 hours $69.60.
(2.) At 3.1 " 15 " " 90.00.
(3.) At 2.5 " 18.65 " " 111.90.

From these figures the expense for the lamps has to be deducted:

(1.) $69.60 — $2.32 = $67.28
(2.) 90.00 — 7.50 = 82.50
(3.) 111.90 — 18.65 = 93.25

And the difference in the returns collected, after the expense for lamps has been deducted, is:

Between lamps of 4 w. and 3.1 w. per candle = $15.22.
" " 3.1 w. " 2.5 w. " = 10.75.
" " 4 w. " 2.5 w. " = 25.97.

This is per electrical h. p. and for 600 hours, but the year is generally rated at 1,800 burning hours; therefore, the above figures have to be multiplied by 3 in order to get the difference per year and per electrical h. p. The result is respectively $45.66, $32.25, $77.91. For a central station of 100 electrical h. p. capacity the difference in the returns is accordingly: (1.) $4,566, (2.) $3.225, (3.) $7,791. And for an electric light company with stations all over the country, which converts 1,000 electric h. p. into incandescent light, the corresponding difference in the returns is (1.) $45,660, (2.) $32,250, (3.) $77,910.

These calculations have, for convenience's sake, been made per electrical h. p. In practice an electrical h. p. bears the ratio to a mechanical h. p. of about 5 to 4 Of the above 16 c. p. lamps, consuming 3.1 watts per candle, 15 were obtained per electrical h. p., and 12 can be run per mechanical h. p. In order to arrive at the practical figures 20 per cent. have to be deducted. In the first instance the difference in the returns was $45,660; deducting 20 per cent., there remain $36,528 in favor of lamps consuming 3.1 w. per candle, compared with lamps consuming 4 w. per candle per year when 1,000 h. p. are converted into light This sum of $36,528 represents an extra dividend of 5 per cent., corresponding to a capital of about $700,000 which was not invested.

To prevent misunderstandings it may be stated once more that the consumer of the light pays in all cases the same, that is, one cent per hour for the burning of one 16 c. p. lamp, but the central station has the advantage of being able to furnish light to more customers with the same power when lamps of high efficiency and short life are used, and therefore collect more money. The consumers also have an advantage since they get better light, because the filament is heated to a higher degree of incandescence, and there are no more "red wires."

It is not necessary to draw conclusions from the above figures as they suggest themselves.

For the lifetime of the lamp F. M. Wright has formed a formula.

L = life in hours. $\left.\begin{matrix}L_o\\V_o\end{matrix}\right\}$ the same for another lamp
V = E. M. F. in volts.

$V_o - V = K \log \frac{L}{L_o}$. K is a constant value to be determined for every system. K is found according to the results obtained by Faussah:

$$V_o - 95 = K \log 3595 - \log I_o \text{ and}$$
$$V_o - 96 = K \log 2751 - \log I_o. \text{ Subtracting}$$
$$1 = K(\log 3595 - \log 2751).$$
$$K = \frac{1}{\log 3595 - \log 2751} = 8.605.3.$$

I am not aware that this formula is used in practice The life of a lamp can be determined approximately in a short time by overheating the filament. A lamp made for use on a 100-volt line and lasting there 600 hours will last about 18 hours only when subjected to a pressure of 125 volts. In this way new shipments of material for filaments are tested in the lamp factories.

It should be the aim of light companies to use for their central stations no lamps consuming more than three watts per candle. Lamps of lower efficiency should be employed only in isolated plants. There is generally in mills, factories and the like an excess of power which does not need to be considered, while the extra expense for new lamps is an important item when power practically costs nothing.

The Edison Electric Illuminating Company of New York.

The annual report of the Edison Electric Illuminating Company of New York is of unusual interest. This company is now the largest local electric illuminating company in the world, the total installation supplied by it being about 50 per cent. larger than that of the Berlin company, which is next in order; and it does approximately 50 per cent. more business than the total of all other local electric illuminating companies, of which there are now seven. The year 1892 witnessed a remarkable progress and closed with every indication of still greater advancement in the future.

Between Dec. 31, 1891, and Dec. 31, 1892, according to Vice-President Bowker's report, the number of customers of the company had increased 51 per cent.; the installation of incandescent lamps, 50 per cent.; of arc lamps, 94 per cent.; and of motors, 90 per cent.; the total installation, including arc lights and motors, 60 per cent. The following table shows the actual increase in the several classes of installation for the past three years:

	Dec. 31, 1889	Dec. 31, 1890.	Dec. 31, 1891.	Dec. 31, 1892.	Increase. 1892.
Customers..... ..	1,213	1,668	2,875	4,344	1,469
Inc. lamps	39,815	64,174	94,485	142,492	48,007
Arc lights	77	254	841	1,637	796
Motors h. p.....	421	697	2,090	3,897	1,807
Total 16 c. p. eq ...	44,795	73,684	122,895	196,932	74,037

Mr. Bowker has also included in his report a brief history of the company since its formation, in 1880, and a description of the present plants and the projected extensions, which are of sufficient interest to warrant the following abstract:

The Edison Electric Illuminating Company of New York, organized by the filing of its certificate Dec. 17, 1880, was the first company to begin commercial electric lighting on a permanent basis. The parent company, the Edison Electric Light Company, had been organized Oct. 16, 1878, and early in 1881 Mr. Edison took the building, 65 Fifth avenue, in which both companies for some time had their general offices, under the executive direction of Major S. B. Eaton. The Edison Company for Isolated Lighting, organized Nov. 19, 1881, and the Edison United Manufacturing Company, organized a year or two later, also had their offices at 65 Fifth avenue, after the Illuminating company had moved its office thence. Bulletin No. 1 of the Light company, issued from 65 Fifth avenue, Jan. 26, 1882, announced the plans for "lighting up New York City." The Edison Illuminating Company purchased the Pearl street property in May, 1881, and it commenced the preliminary work of laying street mains and of wiring houses in July, 1881, having a construction office in Ann street. July, 5, 1882, dynamos were run for testing purposes, and on Sept. 4, 1882, at 3 p. m., the Pearl street station was started, having then six "mammoth steam dynamos" of 125 h. p. each, for the supply of current to customers, lighting during the first month 85 houses, wired for 2,323 lamps. It ran continuously, with a break of but three hours in 1883, until the fire on Jan. 2, 1890. The original street mains were all on the two-wire system, and the early house installations would now be considered very crude. There is probably not a single house installation existing intact to-day in its original shape. At the start, a small junction box was placed in the sidewalk before each house, for the purpose of cutting off the current from outside, but this plan was found undesirable; a few of these boxes still exist, but they have never been used.

The equipment of the Pearl street station and the development of the installation work in connection with it were the scenes of Mr. Edison's first personal labors in this field, and day and night, for many months, the work had his direct supervision. The assistant electricians had a bedroom in the old station, but Mr. Edison's bed was commonly a pile of tubing with a few coats thrown over. That station trained in its early days many of the men who have since made their mark in electric lighting, outside the company as well as within it: John Leib, now chief engineer of the Italian Edison Company, who left the New York company to start the first European station in Milan, which is still under his charge; S. S. Wheeler, now the electrician of the Board of Electrical Control; Charles S. Bradley, the electrical expert of the Fort Wayne-Jenney Electric Company; Charles L. Clarke, the well-known electrical engineer, and others outside, as well as H. J. Smith, the present general operating superintendent of this company, and H. A. Campbell, superintendent of the downtown district. John Kruesi, the present manager of the Schenectady works, who had developed the Kruesi insulating compound for the Edison tubing, made the tubing at a little factory in Washington street and supervised its installation, and Mr. Greenfield, now of the Interior Conduit and Insulation Company, superintended the wiring installation.

(To be continued.)

[7] Mme. Le Breton, "Hist. et. Appl. de l'Elect.," Paris, 1884, pp. 72, 73; W. Sturgeon, "Sci. Researches," Bury, 1850, p. 18; Higg's Translation of Fontaine's "Elcetric Lighting," London, 1878, p. 54.

[8] These are referred to at pp. 651 and 652, vol. xxi., as well as at pp. 11 and 12, vol. xiv., of the Eighth "Brittanica," and are detailed in Oersted's "Efterretning om nogle nye, af Fourier og Oersted . . . ," Kiobenhaven, 1822-1823, translated into French as mentioned in vol. xxii. of the *Annales de Chimie et de Physique*. See also the "Oversigt over det Kongl . . . ' for 1822-1823 and 1823-1824. See Poggendorff, vol. iii., pp. 309-312; "Catal. Sci. Papers Roy. Soc," vol. i., pp. 697-701; Biog. Sketch by P. L. Möller, "Oersted's Character und Leben." 1851, also Hauch und Forchammer, 1853; Obituary notice in *Jour. Frankl. Inst.*, 1851, vol. xxi., p. 358; Humboldt, *Cosmos*. 1849, vol. i., pp. 182, 185 and the 1819-1820 entry of "Magnetic Observations," in vol. v.; "Oversigt over det Kongl. danske Videnskabernes Selskabs Fordhandlinger" for 1822. 183", 1834-1835, 1836-1837. 1840-1842, 1847-1849: Poggendorff's *Annalen*, vol. iiil.; "Ursins Magaz. f. Kunstnere. . ." vols. i. and ii.; Dict. of Electromagn., 1819; Sturgeon's *Annals of Electricity*, vol i., p. 121; Hatchette "On the Experim . . . of Oersted and Ampère," *Phil. Mag.*, vol. lvii., p. 40; *Phil. Mag.*, vols. lvi., p. 394; lvii., pp. 47-49; lix., p. 462; *Phil. Mag. or Annals*, vol. viii., p. 230; *Annales de Chimie* for Aug., 1820, p. 244; S. S. Eyck "Over de magnetische. . . ." *Bibl. Univ.*, 1821; Translation by H. Sebald, of H. C. Oersted's 'Leben. 1853; Michaud, "Biog. Univ.," vol. xxxi., p. 196; P. L. Möller, "Der Geist in der Natur" (The Spirit in Nature); Elie de Beaumont, "Memoir of Oersted" ("Smith. Rep. for 1863); Callisen, "Medicinisches Schriftsetier-Lexikon;" W. Sturgeon's "Sci. Researches," Bury, 1850, pp. 8 (for 1807), 9-12 (translation), 17, 18, 28, 415; "Note sur les experiences . . . de Oersted, Ampère, Arago, et Biot," *Annales des Mines*, 1820; L. Turnbull, "Elec. Mag. Tel.," 1853, pp. 45, 221; J. F. W. Herschel's Preliminary Discourse, 1858, pp. 244, 255; Fahie, "Hist. Elec. Tel.," 1884, pp. 270-275, and *Journal of Soc. Tel. Eng.*, vol. v., pp. 459-469, for Engl. Transl. of Oersted's Latin pamphlet, and his biography by R. L. Madsden; Harris, "Rud. Elec.," 1853, p. 171; Mrs. Somerville, "Con. of Phys. Sci.," 1846, p. 314; Noad, "Manual," p. 642; "Lib. Univ. Know." (El. Magn.), pp. 4, 79; Lardner's "Lectures," 1859, vol. ii., p. 119; Tomlinson's "Cycl. Useful Arts," vol. i., p. 559; Ure's Dict. of Arts, 1878, vol. ii., p. 233; Henry Martin's article in Johnson's "New Cyclopædia," 1877, vol. i., pp. 1,512, 1,514; "Nyt Biblioth. f. Physik," Band i, auch Scherer's Nord. Arch., ii.; "Tidskrift f. Natur . . . ," i., 1822; Schumacher's Astron. Jahrbuch for 1838; L. Magrini, "Novo metodo. . . ." Padova, 1836; Boisgeraud "On the Action of the Voltaic Pile. . . ." *Phil. Mag.*, vol. lvii., p. 203; *Sci. Am. Suppl.*, No. 454, p. 7,241; Schweigger's *Journal*, vols. xxix., xxxii., xxxiii., iii.; Figuier, "Expos. et Hist." 1857, vol. iv., p. 393; "Engl. Cycl., "Arts and Sci.," vol. iii., p. 782; Brande's "Man. of Chem.," London, 1848, vol. i., p. 248; Prime's "Life of Morse," pp. 264, 451; Dr. Henry's "Elm. of Exper. Chem.," London, 1823, vol. i., pp. 193-203; *Jour. of the Frankl. Inst.* for 1851, vol. xxi., p. 403; "*La Lumière Electrique*" for Mar. 19. 1887, p. 593, and for Oct. 31, 1891, p. 201, etc.; Sir. Wm. Thomson, "Math. Papers," Reprint, etc., 1872; "Encyl. Metrop." (Elect. Mag.); G. B. Prescott, "Elect and the El. Tel." 1885, vol. i., p. 91; "Smithsonian Report" for 1878, pp. 272, 273 (note); Bacelli (L. G.), "Risultati . . . ," Milano, 1821,

Magnetometric Method of Measuring Losses in Iron Under Alternating Currents.

BY J. F. MOORE.

In The Electrical World of June 4, 1892, there appeared an article on "Magnetization Curves of Iron Under Alternating Currents." The experimental work in the article referred to was performed by a method suggested by Dr. Louis Duncan, which might be called the "dynamometer method." Shortly after the publication of that article, the writer had occasion to perform a series of experiments by a method which up to that time, it is believed, had never been used.

The fundamental object in these experiments was to establish a simple and accurate way of obtaining the "iron loss" for the predetermination of the efficiency of transformers. In previous methods the measurement of the induction (B) or the intensity of magnetization (I) had been accomplished by measuring an induced

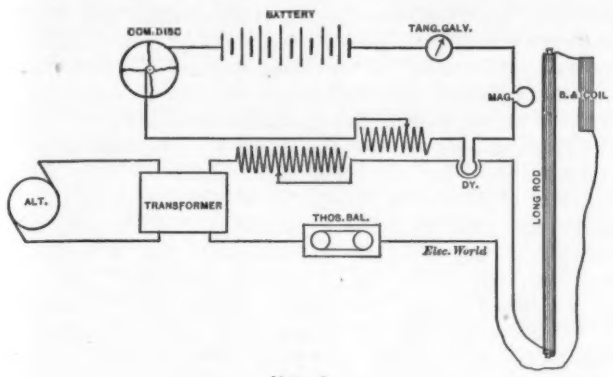

FIG. 1.

E. M. F. To pass from instantaneous values of E. M. F. to the corresponding absolute values of (B) or (I) is a laborious process, not to mention the inaccuracies that are apt to be involved.

In order to measure all quantities directly the sample of transformer iron is procured in the form of long strips or wires, which are built up so as to make long rods. These are supplied with magnetizing coils, as if they were to be used for ballistic or magnetometer experiments. An alternating current of the same periodicity as that for which the transformer is to be used is passed through the magnetizing coil. It produces in the sample waves of magnetism of the same periodic time as the current. Instantaneous values of the magnetizing current can be measured by passing the current through the stationary coil of the electro-dynamometer, through the movable coil of which there can be sent, at any definite point in the wave of alternating current, an instantaneous direct current, as described in the previous article on this subject. The corresponding values of magnetization in the long rod can be measured by suspending a small helix of insulated wire near one of the poles of the long rod. By passing the same instantaneous current through the helix at a definite point in each recurring cycle of magnetism, the helix is made for a very short time a magnet whose strength is proportional to the number of turns of wire on the helix, and to the current passing. It is readily seen that a deflection will result; and its amount will be proportional to the product of the strengths of magnetism developed in the long rod and the helix during the short time the helix is a magnet. By passing the instantaneous current at different points in the wave of magnetism, different magnetometer deflections will be obtained at each point; and by keeping the mean value of the instantaneous current constant, the deflections of the helix will be proportional to the strength of magnetism in the long rod at the point in the wave of magnetism at which the instantaneous current passed. By this method both quantities for obtaining the hysteresis loss may be read off directly.

The current dynamometer and commutating disc were the same as used in the previous experiments. The instantaneous current through the movable coil of the dynamometer and the magnetometer helix was left constant at 1-10 ampere. The magnetometer was made of a helix of insulated wire, which was 2.5 centimetres in length by 1.5 centimetres in diameter. This was suspended bifilarly, within a stout wooden upright, which was made fast to a suitable base. A mirror was attached to the helix, which allowed its deflection to be read by a telescope and scale. The length of the helix was carefully adjusted to lie in the magnetic meridian. This could easily be tested before an experiment, by passing the instantaneous current through the helix; if no deflection occurred, it was known to be in the proper position. The magnetizing coil of the long rod was placed vertically, and before inserting the specimen a balancing coil was so adjusted that no deflection of the magnetometer helix was caused when the full magnetizing current was passing. At the end of an experiment the balancing coil served as a means to calibrate the magnetometer, by passing a known continuous current through it. The arrangement of apparatus is shown in Fig. 1.

In Figs. 2, 3 and 4 are shown three results from a series, taken by this method, from a rod 122.8 centimetres long, made up of forty No. 16 iron wires. The lag between the magnetizting force and the remittent magnetization, as caused by eddy currents, is very plainly shown. In the results presented, a correction is introduced by resolving the magnetizing force in the direction of the resultant magnetization, and subtracting from it the component of eddy currents resolved in the same way. It is to be noticed that the corrected losses agree very closely with "static" hysteresis losses, at corresponding magnetizations, obtained either by the ballistic or magnetometer methods.

It might also be pointed out that this method lends itself to an easy and exact experimental determination of the losses from eddy currents at any rate of alternation. It will be seen that by substituting for the instantaneous current through the magnetometer helix an equivalent continuous current, and for the alternating magnetizing current a continuous current (to be varied by "steps," as in Professor Ewing's "static" experiments), a "static" hysteresis curve may be obtained from the same sample as used under alternating currents without changing any of the magnetic constants. A comparison of the two results, taken under different conditions—that is, under alternating and continuous magnetizing forces—will show the effect of eddy currents at once.

As a final application of the alternating current magnetometer, it is proposed to employ it in photographing hysteresis areas from iron magnetized by alternating currents. For this purpose the magnetometer helix will be held by two horizontal supports from a rigid frame, and the whole system suspended by a suitable torsion wire. In this way the magnetometer helix may be deflected, either in a vertical or horizontal plane. By placing the sample to be tested as in the previous experiments, and arranging a coil above the magnetometer helix, concentric with the magnetometer suspension, so that its force at the helix will be proportional at every instant to the magnetizing force acting on the sample, the magnetometer helix will be deflected to a position which is the resultant of the two deflecting forces acting upon it. The deflection can be read by means of a mirror attached to one end of the helix. By moving the contact brush over the commutating disc an amount corresponding to 360 degrees, the hysteresis area corresponding to one cycle may be projected upon a screen, or upon a sensitized plate and photographed. This method has an evident advantage, in that it may be used equally well at any rate of alternation without being affected by the inertia of the moving parts.

The National Electric Light Convention at St. Louis.

The St. Louis Electrical Club met on Saturday, Jan. 21, at its new quarters in the Equitable Building to consider the entertainment of the National Electric Light Association to meet in St. Louis, Feb. 28–March 2. About 50 members of the club were present. By invitation Messrs. Gaiennie, King, Moffatt and Cox were present, representing the Autumnal Festivities Association.

Mr. Robert McCulloch, president, called the meeting to order.

Mr. McCulloch called upon the gentlemen of the Autumnal Festivities Association for their views.

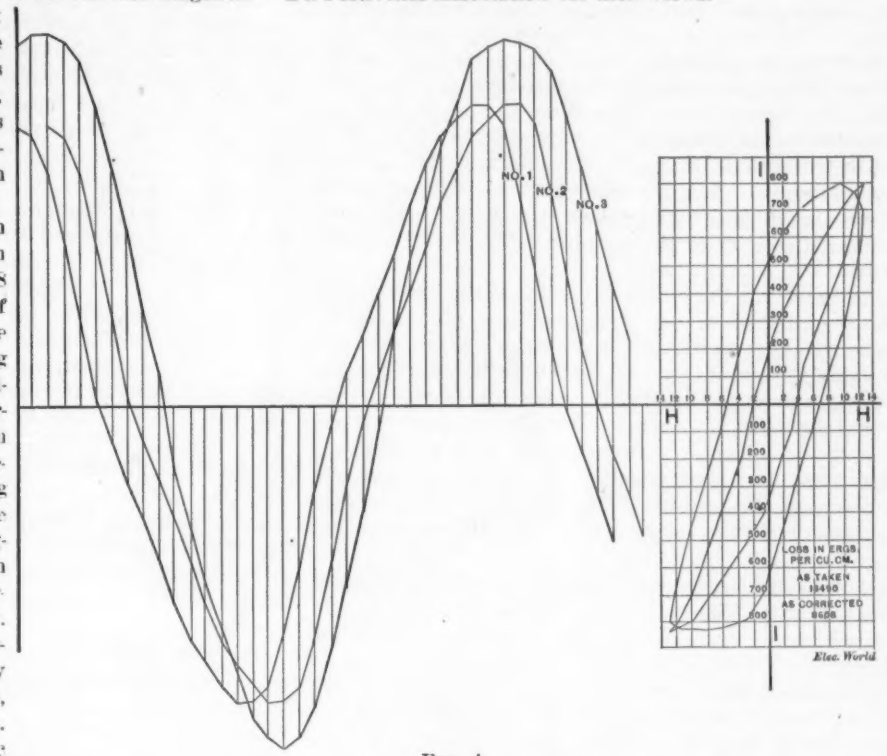

FIG 4.

Mr. Gaiennie, Mr. King and Mr. Cox expressed their opinion that that association and the public generally would be glad to assist to make the affair creditable to the city and pleasant to the visitors.

Mr. Anderson spoke for the Merchants' Exchange, saying that it was a progressive organization, and wanted all such bodies as these electricians to come to St Louis. He was sure the members of the Exchange would do all in their power to entertain these visitors in a royal manner.

Mr. Ayer, president of the National Association, outlined some of the features of the approaching convention. Some 300 visitors are expected. The meeting would be one mainly for business.

Mr. Ayer said that he was extremely happy to announce that the feature of the meeting would be the lecture on Wednesday night, which would be delivered by Nikola Tesla, whose marvelous achievements in the domain of electrical research are the wonder of the world There are several people in St. Louis who knew Tesla, and they felt as though it would be a fitting tribute to this remarkable man if he should be given a reception. The Tesla feature of the convention would give the meeting a worldwide interest, for every word that Tesla utters from a public platform is quoted in all lands and in all languages; and worldwide attention would be given to St. Louis through Tesla's lecture here.

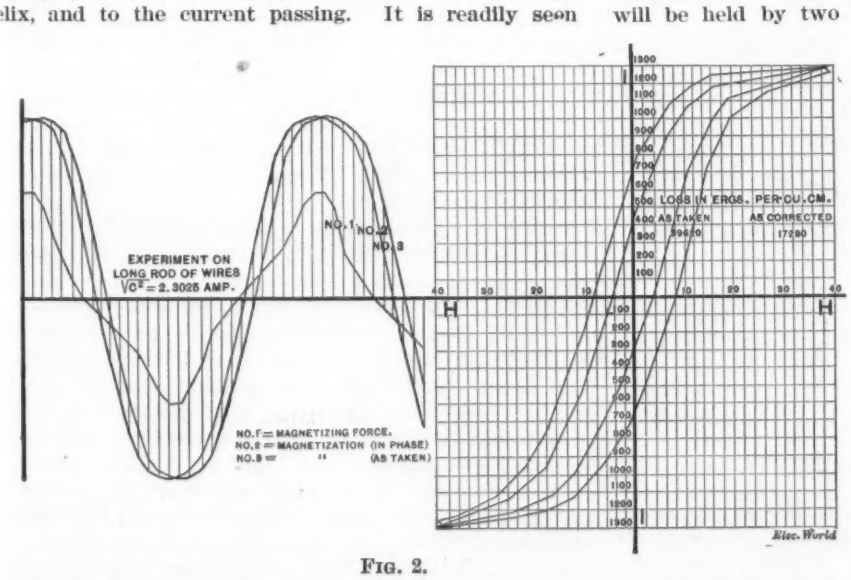

FIG. 2.

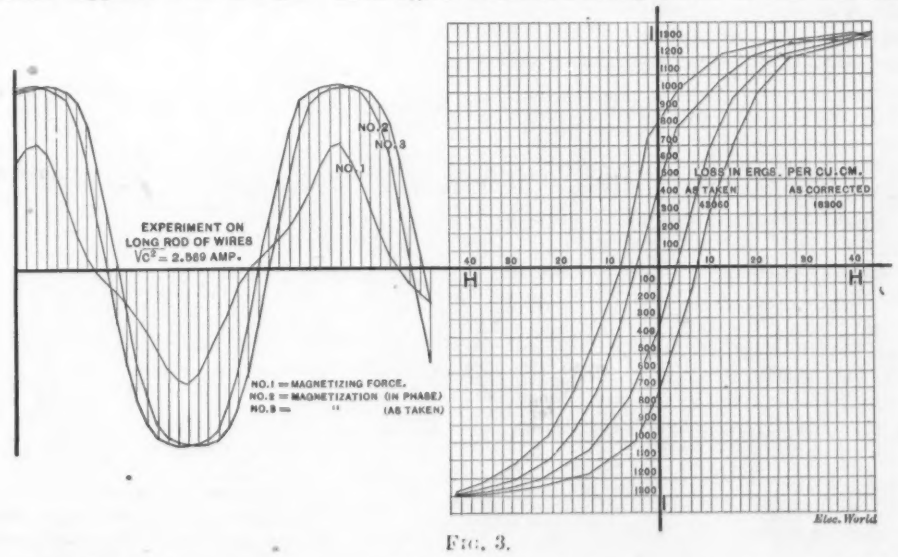

FIG. 3.

After some discussion a financial committee and an executive committee were named.

Mr. J. A. J. Shultz was appointed chairman of the Finance Committee, and with him were associated James I. Ayer, E. D. W. Meier, Geo. P. Jones, T. M. Ambler Louis Nahm, C. R. Scudder, Robert B. Annan, Marcus Bernheimer, John S. Moffitt, Frank R O'Neill, F. J. Wade, L D. Kingsland, Frank Shepleigh, Frank Gaiennie. Goodman King, Ben Eiseman, Douglas Cook, Ellis Wainwright, A. Siegel, S. G. Booker and John C. Wilkinson.

The Executive Committee was named as follows: Louis Nahm, Chairman; James I. Ayer, Frank Gaiennie, Nathan Frank and Coodman King.

Some features of the approaching convention were discussed and then the programme as outlined by Mr. Ayer was approved.

Two halls are under consideration in connection with Mr. Tesla's lecture, viz., Entertainment Hall, with a seating capacity of 1,300, and Music Hall, which can accommodate 4,000. Both of these are in the Exposition, which is quite centrally located. It is believed that Mr. Tesla's lecture will attract such a vast audience as to require the larger of the two. As regards the entertainment of the visiting members of the association the simple announcement that Mr. Louis Nahm, of the Electric Manufacturing Company, is chairman of the committee having that in charge is sufficient to guarantee that nothing desired will be left undone.

A reception committee, made up of members of the various other committees, will be appointed shortly. This will be the largest of the committees appointed, and portions of it will be assigned to the various hotels, where they will be on hand to make comfortable the visitors from without the city. This committee will be distinguished by the association budge with yellow decorations, which will be distributed to them some time in advance of the convocation.

The Autumnal Festivities Association above referred to is an organization of the progressive business men of St Louis, who have the best interests of the city at heart, and who annually spend large sums of money in entertainments of the Mardi Gras and Veiled Prophet order, for the purpose of attracting the attention of the business world without to the advantages possessed by St. Louis as a business centre. This organization will co-operate with the Electric Club to make the occasion of the convention a memorable one, not only in the history of the association but also in that of St. Louis.

A letter from Mr. George Forbes, the great English electrical authority, just received, states that he will be in this country at the time of the convention and hopes to attend.

The transportation arrangements have not yet been sufficiently completed for announcement, but this much is already certain that they will be most complete, and that the special train which is to take the members to St. Louis will be by far the finest ever made up for such an occasion.

Secretary Porter, who has just returned from St. Louis, reports that city as fully alive to the importance of the convention, and that the latter bids fair to be the most successful of the long series of successes already achieved by the association.

Committees for the Chicago Electrical Congress

At the meeting of the Advisory Council of the Chicago World's Congress of Electricians four committees were decided upon to take up the active work in connection with preparations for the Congress. These committees were: The Finance, three members; Executive, five members; Invitations, five members, and Programme and Papers, eight members. Dr. Elisha Gray, Chairman of the Advisory Council, has now selected the following members of these committees, from the Advisory Council and his local Chicago committee:

Executive Committee.—Prof. Elihu Thomson, Enos M. Barton, G. M. Phelps, F. S. Terry and Prof. B. F. Thomas.

Finance Committee.—B. E. Sunny, Prof. E. J. Houston and W. A. Kreidler.

Programme and Papers Committee.—Prof. H. A. Rowland, Prof. H. S. Carhart, Carl Hering, A. E. Kennelly, Prof. W. A. Anthony, Prof. F. B. Crocker, Prof. E. L. Nichols and Prof. T. C. Mendenhall.

Invitations Committee.—T. C. Martin, Dr. Louis Duncan, Prof. C. R. Cross, T. D. Lockwood and C. H. Wilmerding.

Of all these committees, and any others that may be formed, Dr. Elisha Gray is a member ex-officio. He will participate actively in the work of each. It is proposed to establish headquarters for the Congress at Chicago at an early date, at which Mr. R. W. Pope, the secretary of the American Institute of Electrical Engineers, will probably be stationed to carry on all the detail work in conjunction with Prof. H. S. Carhart.

Meeting of the New York Electrical Society.

The 151st meeting of this society will take place on Wednesday, Feb. 8, 1893, at 8 P. M., at Columbia College, Madison avenue and Forty-ninth street. The evening will be devoted to an experimental and illustrative lecture on "The Telephone, and How We Talk from New York to Chicago." The lecture will be divided in two parts, to be given respectively by Mr. J. J. Carty, elecrician of the Metropolitan Telegraph and Telephone Company, of New York, and Mr. F. A. Pickernell, engineer of the American Telegraph and Telephone Company (Long Distance Company). Through the kindness of the Long Distance Telephone Company the Chicago telephone line has been placed at the disposal of the society for the evening and telephone receivers distributed throughout the room will enable the audience to hear speech and music transmitted from Chicago.

The Second Meeting of the Canadian Electrical Association.

On Wednesday of last week the second convention of the Canadian Electrical Association was opened at the School of Practical Science, Toronto. The attendance was fair and representative of the electrical industries of Ontario and Quebec. The session continued through Wednesday and Thursday, and a number of interesting papers were read and important business discussed.

President J. J. Wright called the first meeting together at 2 P. M. on Wednesday. He referred to the work of the past six months, pointing out that rapid advancement had been made in every branch of the electrical industry. The extension of the application of electricity as a motive power to street railways and tramways had developed with a rapidity which was without parallel, while the manufacture of arc and incandescent lighting apparatus was even a more important branch at the present day than it had ever been before. The same progress was to be noted in the field of the telegraph and telephone. While solid and substantial progress had been made by conservative management, a word of caution should be given to investors in electrical securities. As a result of such remarkable development a great many schemes, having electricity as a basis, had sprung up, the inevitable failure of which would tend to discredit, to a certain extent at least, legitimate enterprise and profitable business. Many of the propositions of long-distance transmission of power might be classed under this head, for the present at least. He thought that the members of the association should unite in a closer bond, so that those whose interests are to a certain extent identical might be of mutual assistance. It was an important thing to decide whether it would not be advisable to organize sub-sections of the association in order to more successfully attend to details that would be somewhat beyond the scope of the association in its entirety.

Mr. T. R. Rosebrugh was then introduced, and, on behalf of the School of Practical Science, extended a warm welcome to the convention.

Secretary-Treasurer C. H. Mortimer presented his report for the last half year, which showed that the organization had reached its present thriving condition chiefly through the efforts of individual members, and predicted for it a career of usefulness and prosperity. During the past six months there had been added to the membership seven active and four associate members, making a total of 119.

The Committee on Statistics presented its report, asking for authority to have printed a number of blanks containing a set of questions to be submitted to every electric light-power, telegraph and telephone company within easy communicating distance, and to have statistics compiled from the answers received. This authority was granted.

Mr. George Black, of Hamilton, presented a paper on "Electrical Measurements," and Mr. W. A. Tower, of Toronto, one on "Underground Construction," both of which excited considerable interest and discussion. Abstracts of these papers will be found elsewhere in this ssue.

At the conclusion of this session a number of members visited the School of Practical Science, inspecting its laboratories and testing rooms, and also the plants of the Toronto Incandescent Electric Light Company and the Toronto Electric Light Works.

In the evening a very enjoyable dinner was given at McConkey's restaurant. The occasion was an informal one, and, instead of the regular toasts, semi-humorous speeches and songs were in order. Among the speakers were President J. J. Wright, Principal Galbraith, of the School of Practical Science, and Messrs. Hugh Neilson, A. A. Wickens, George W. Sadler, John Carroll, J. W. Taylor, P. M. McQuade, A. A. Wright (Renfrew), and C. H. Mortimer, Messrs. Starr and Martin favored the company with numerous songs.

The second day was given up to the reading of papers by J. M. Campbell, of Kingston, on "Free Wiring;" R. G. Bloch, of Hamilton, on "The Incandescent Lamp," and Professor Rosebrugh, of the School of Practical Science, Toronto, on "Speed Control," the two former appearing elsewhere in these columns.

Among those present were the following:

President, J. J. Wright, manager of the Toronto Electric Light Company; vice-presidents, John Carroll, Eugene Phillips, Electrica Works, Montreal; secretary-treasurer, C. H. Mortimer, publisher *Electrical News*, Toronto; D. A. Starr, Royal Electric Light Company, Montreal; H. O. Fisk, Electric Light Company, Petersboro'; A. B. Smith, Canadian Board Fire Underwriters, Toronto; D. Thomson general manager Hamilton Electric Light and PowerCompany; John Yule, manager Guelph Gas and Electric Light Company, Guelph; Thomas H. Wadland, Bell Telephone Company, Hamilton; L. B. McFarlane, Bell Telephone Company, Montreal; E. Carl Breithaupt, Berlin; A. M. Wickens, Toronto; George Black, G. N. W. Telegraph Company, Hamilton; J. A. Baylis and W. A. Tower, Bell Telephone Company, Toronto; R. G. Black, Hamilton; A. T. Smith, Bell Telephone Company, Kingston; B. J. Throop, Bell Telephone Company, Brantford: George M. Wright. Montreal; J. H. Greer, Peterboro'; H. Beaumont, Kay Electric Works, Toronto; J. W. Taylor, Peterboro'; J. A. Kammerer, Royal Electric Company, Montreal; Geo. W. Sadler, Robin & Sadler, Leather Belting Company, Montreal; O. C. Armstrong, Brooks Manufacturing Company, Toronto; W. Bourne, Toronto Electric Light Company; H. S. Thornbury, Toronto Electrical Works; W. J. Jones, Bell Telephone Company, Toronto; Hugh Neilson, Bell Telephone Company, Toronto; W. B. Evans, Bell Telephone Company, Toronto; W. R. McLaughlin, THE ELECTRICAL WORLD, New York; W. J. Clarke, Bell Telephone Company, Toronto; R. F. Carter, Niagara Falls, Ont.; Chas. B. Hunt, Electric Light Company, London; Alex. Stark, Bell Telephone Company, Toronto; John Langton, Peterboro'; James P. McQuaide, National Conduit Company, New York; A. C. McCallum, Peterboro', and others.

Electrical Measurements.*

BY GEO. BLACK.

In the early days of the telegraph very little was known of the science of electricity; the laws of the current and of resistance were imperfectly understood, and escape or leakage was our special bugbear. In the good old days we were satisfied to believe that the current flowed, and we put on battery enough to give a working circuit. The successful laying of the Atlantic cable led to more scientific methods in the telegraph systems of this continent. The adoption of duplex and quadruplex transmission called for lines in first-class condition.

The advent of electric lighting introduced comparatively heavy currents of great intensity, and new terms had to be coined to suit the altered circumstances. The names of electric units are perplexing to the uninitiated, failing to convey an idea of their meaning, being adopted from the names of well-known electricians and mechanicians who have left their "footprints on the sands of time." I shall only use a few of these terms, what we may call the practical every-day units. It is evident that any one familiar with the application of Ohm's law can feel the pulse and prescribe for his wires at any time on short notice.

In England and on the Continent the telegraph wires are tested daily for insulation and resistance. They are run over rapidly with a detector or a tangent galvanometer and the deflection tabulated. A battery is first joined up with the galvanometer and a known resistance, say 5,000 ohms, and the deflection noted, say 45 degrees—this is called taking the constant of the galvanometer. The lines are then tested with distant ends open, then distant ends closed, and deflections noted. Date, state of weather and temperature are also recorded for comparative purposes. Any variation from the normal record is gone over again with a different galvanometer or a Wheatstone bridge, and the defect rectified at once. By this means troubles are anticipated before they become serious.

Electric light companies are supposed to test daily with a magneto, but that does not reveal anything very definite, it will only tell if circuit is dead, open, or that there is a leak in the line. The magneto will not reveal a short circuit nor locate an escape unless the line is tested in sections. The telephone companies also call up customers and test lines with magnetos, but unusually heavy resistances may creep in and not be detected by this means and nothing will be done till the line offers sufficient resistance to attract attention. Electric light companies could test with a small battery and galvanometer or a milli-ampère meter in day time for resistance, using a magneto for insulation tests. Telephone companies could run over their lines during the silent watches of the night when customers are sleeping. Electric railways should take the resistance of all their circuits at various points, say, every quarter of a mile, and at junctions or intersections when first installed, and at regular intervals afterwards. By so doing weak spots, such as broken bonds, defective grounds, etc., may be detected at once and remedied. An occasional run over the lines with voltmeters and ammeters also is recommended. It is well to test with as small a battery as will suffice, as heavy currents sometimes fail to indicate faults, the current welding or expanding the weak spot, or jumping the gap. Lines will sometimes apparently test better in wet weather than in dry, the escape reducing the apparent resistance and rain assisting the conductivity of bad joints. In testing for insulation, as heavy a battery as convenient should be used, especially ou short lines, unless you have an extra sensitive galvanometer. Long lines will appear to test worse than short ones.

With a good galvanometer and a suitable resistance box it is an easy matter to do plain testing, but difficult problems present themselves which try the metal of the tester. A dead ground or a well defined cross may easily be located. But usually grounds have considerable in them and crosses do not always make good contact. An example or two from actual practice may be permitted. Wire No. 20, running east from Hamilton, was grounded between Hamilton and St. Catharines. The wire in good condition measured 560 ohms per mile. The line measured through the fault with distant end open 4,000 ohms. Another wire, No. 19, of similar resistance, was looped at St. Catharines and measured through the fault on 20 with Hamilton end of 20 open, which went 4,800 ohms. The loop was then measured to prove former test and went 1,120, or twice 560. We now add the two first tests together, 4,000 + 4,800 = 8,800. We deduct third, leaving 7,680 as remainder. This represented the resistance of the leak, measured *twice*, or 3,840 as resistance of the leak. Now to locate it—the first test stood at 4,000—deduct 3,840, leaves 160, or 10 miles from Hamilton; this proved by the second measurement also. Where the distant office uses a galvanometer, a second wire may be dispensed with, but where practicable the tester should prove his own measurements. As a single wire this would measure, first from Hamilton 4,000, then from St. Catharines, 4,240. Added together, 8,240, less resistance of wire in good order, 560, or 7,680 for fault twice measured. In this instance the repairer found a broken stay wire touching dry sandy soil at the distance indicated. Measurements made without a knowledge of the usual conditions

*Abstract of a paper read before the Canadian Electrical Association.

of the wire are sometimes misleading, owing to extra resistance not looked for in the measurements.

To measure a cross it is safer to treat it as a leak to earth. You thus eliminate any resistance which may be in the cross. Ask an office beyond the cross to open one wire and ground the other. First measure the loop through the cross, then each wire through the cross to distant ground. Thus:

Nos. 1 and 2 crossed between you and an office 25 miles distant. No 1 is opened and No. 2 grounded at that office. Usual resistance of lines, 16 ohms per mile or 400 to distant ground.

Loop measures 384, No. 1 to ground measures 400, No. 2 to ground 400, indicates no resistance to cross. Half the resistance of loop divided by 16 gives the distance as 12 miles from your end. If wires are of different resistance the case is a little more difficult. Say No. 1 went 20 ohms per mile, and No. 2 went 16, the measurements would be: Loop, 432; No. 1 to No. 2 ground, 448; No. 2 to No. 1 ground at distant end, 452; added together make 900, the resistance of both wires. Then 36 (20 and 16) into 432 goes 12 miles. If any resistance in cross it will appear in excess of measurement and should be deducted to get distance. Take an example of two wires crossed by a high resistance, say a mass of wet kite tails. Each wire measures 400 to distant office, each wire measured through the cross to distant grounds 8,400, indicating 8,000 ohms in the cross. Now measure the loop with distant ends open, it goes 8,200. Deduct 8,000 for fault and divide half of 200 by the mileage for distance of fault, or 6¼ miles.

A word about leakage to the earth. Telegraph and telephone companies have to depend upon their insulators entirely, but light and power companies sometimes depend upon the insulation of their wires and are not as careful as they might be about other insulation. The so-called insulation of wires in many cases is very delusive in wet weather, and the only safe rule is to act as if they were naked wires.

Samples of wire should be tested for insulation, and for waterproof and fireproof qualities.

Free Wiring.*

BY J. M. CAMPBELL.

When arc lighting was first introduced in this country it was customary to put lamps and wires into the premises of the consumer free of charge. This was no doubt the origin of free wiring. As the business increased and incandescent systems of lighting were introduced this practice was in a great many instances still continued. The simple wires of the arc system multiplied in number and size. The labor of installing these wires increased greatly, a better insulation was called for, incombustible fittings were the order of the day, until at the present time, if interior wiring for any incandescent system is put in properly, it requires good material and good workmen. Both of these cost money. In the face of all this a great many of the local lighting companies sail serenely on, wire up places of business and houses free of expense to the owners, charge the outlay to "Capital Account" and post it up in their books as an asset. The stockholders at the end of the year very likely obtain a stock dividend, and may consider themselves very fortunate if they are not called on to subscribe for a further issue of stock for extensions and improvements, unfortunately improvements to the property of other parties, and which, if an asset at all to the lighting company doing the work, is of a very doubtful character, the kind of an asset which should be written off the books every year as a dead loss. Where do we hear of gas companies piping up customers' premises free of charge? This is seldom if ever done, and yet in small towns the gas making industry does not seem to be any great bonanza, and it is generally conceded that gas light can be manufactured cheaper than incandescent electric light.

No doubt when an electric lighting plant is installed in a town a greater number of customers can be obtained by supplying all interior work free of charge, but when this is done the company is at the mercy of the consumer. On the slightest pretext the company is ordered to take out the lights and wires by the consumer, who has not any financial interest in the stuff, and the company's assets of so many lights wired up becomes a scrap heap of very little value. If the customers put in their own interior work, it saves a large outlay to the company in the first place. They then have an interest in it and will not be inclined to cut off the current without good reasons. When pay day comes around the collector will find that he has a different man to deal with than our friend with free wires. By abolishing free wiring a better class of customers will be secured. The lighting company's expense will be cut down considerably, as all changes and repairs can be charged for. There will not be so much capital invested and therefore less dividends to pay, and on that account a cheaper service can be given. Give the people a perfect service at as low a figure as possible, and make them pay for everything inside of and including the main line cut-out.

The company may not secure quite as much business, but it will show a much greater net gain at the end of the year. The business will increase much quicker than the capital account, and by and by when a street circuit must be extended or a new dynamo put in the money will be on hand to do it with which would otherwise have been squandered on free wiring.

* A paper read before the Canadian Electrical Association at Toronto.

Probabilities as to the Success of Distribution of Power at Considerable Distances by High Tension Currents of Electricity.*

BY E. CARL BREITHAUPT.

The problem of the transmission of power involves two distinct cases: (1) Distribution in small quantities over limited areas, as *e. g.*, central station distribution. (2) Transmission of energy in large units over considerable distances, as where a large power supply is available, but at an otherwise inaccessible place. Under this head again two cases may arise—where all the energy is to be delivered at one place, and where considerable quantities are to be delivered at each of several places.

Of the purely mechanical methods of transmitting power that of belts and shafts is no doubt the best for very short distance. Long lines of shafting, however, present some difficulty both in construction and operation.

For greater distances wire rope is often used with good results, the best example of which is the case of cable railways. According to Beringer's table, the efficiency of this method drops from 93 per cent. at 500 metres (about one-third of a mile) to 13 per cent. at 20,000 meters (12.4 miles). At a recent cable railway test at which the writer assisted we found that altogether the road was operated quite economically. Where traffic is heavy, the system is undoubtedly a good one.

Transmission by compressed air distributed through pipes is available for greater distances. The efficiency of such a system varies from 55 per cent. at 500 metres to 40 per cent. at 20,000 metres, and can be increased about 20 per cent. if the air be heated.

Transmission by steam distributed through pipes and by hydraulic means may also be mentioned as among the purely mechanical methods, but their application is very limited; where gas is cheap the gas engine can be used to good advantage.

The problem of distribution over a limited area is in general best solved by electrical methods, and of these the most successful is that of distribution by direct current at constant pressure. The dynamos and motors of this class, shunt and compound wound, usually have an efficiency of over 90 per cent. (*i. e.*, the larger sizes), and the loss on the line can easily be made quite small, so that we may reasonably expect to have over 75 per cent. of the mechanical horse power delivered to the dynamo for actual use at the motor pulley. Moreover, the cost of such a plant is not nearly so high as with any of the purely mechanical means, and a pressure can be used which is perfectly safe.

Any system of long distance transmission to be successful must, of course, deliver power at the receiving end cheaper than it can there be produced. This practically limits the case of long distance work to cheap sources and large units. Its principal factors then are: 1. Primary cost. 2. Working expense. 3. Safety.

In electrical transmission we have at present three different methods, viz.: 1. By means of direct currents either at constant potential or constant current. 2. By means of simple alternating currents. 3. By means of the three phase alternating so-called rotary current. In any case, unless we can thereby effect a corresponding reduction in the working expense, coupled with a fair degree of safety, the cost of our plant must be reasonably low; this means that the machinery must be as simple as possible; further, it should consist of the fewest possible number of interdependent parts, so as to reduce the liability of a breakdown to a minimum, and it should not be liable to get out of order.

In all these respects, as in many others, the direct current system so far has the advantage, and we are inclined to think that very many if not most of the cases arising in ordinary practice can be best dealt with by this method. The maximum potential difference we can safely use on an armature is probably 2,000–3,000 volts, though some engineers claim it can be carried as high as 5,000 volts. Take, *e. g.*, a case where a good steady water supply of 100 to 150 h. p. is available at a distance of, say, 5 miles, and where we can afford to allow a loss of 20 per cent. on the line. Using a 100-h. p., 2,000-volt generator, the required diameter of the line on a complete metallic circuit would be only slightly over two-tenths of an inch, about No. 4 B. & S. gauge. With an efficiency of 90 per cent. in the machines we should still have 64 h. p. available at the motor pulley. Taking the cost of the machinery as $30 per h. p., copper as 20 cents per pound, poles as $4.50 set, and allowing 35 poles per mile, the first cost of our plant would sum up to $127 per h. p. delivered.

For distances where a high pressure is required, it has been proposed to use a number of dynamos coupled in series and an equal number of motors also in series at the receiving end. The scheme has, we believe, been tried in France, where one of the difficulties encountered was that in case of a break in the circuit the machines were invariably burnt out. A Swiss firm has submitted plans on this system for carrying 800 h. p. from Niagara Falls to Chicago. They propose to use 10 machines of 100 h. p. and 3,000 volts, each making a total initial pressure of 30,000 volts, and allow a loss of 24.5 per cent. on the line. Counting on an efficiency of 90 per cent. in the machines the plant would have a total efficiency of 60 per cent. The motors at the receiving end would drive dynamos which in turn would supply current at any desired potential difference. Taking the distance as 500 miles, we find that to get the results above stated we should require a wire having a diameter of about .37 inch (about No. 00 B. & S. gauge) for a complete metallic circuit. The total weight of copper would thus be something over 1,063 tons.

Alternating currents furnish a ready solution of many of the difficulties in the problem of power transmission, but as yet we are in the position of the man of whom the German proverb says, he had the soup but not a spoon. We can generate at low voltage, transform by means of stationary apparatus, which requires no further attention, to a high voltage, thus to be transmitted over the line and again reduced to any desired potential difference at the other end. The method involves more interdependent parts, and the first cost of such a plant is generally somewhat higher than where continuous currents are used. Further, for alternating currents the practical resistance of a wire is not the same as for continuous currents, since periodicity and self-induction must now also be considered. It is no longer a constant quantity, whatever the current, and to do the same work we may, and often do, require a wire of greater cross-section. Again, the E. M. F. now varies periodically between zero and a certain maximum; the effective E. M. F. is therefore only a mean, and we must insulate against a greater voltage than that indicated.

Whether it be advisable to use step-up and step-down transformers will depend on distance and the line loss we can allow. In every case the cost of transformers must be balanced against the additional cost of copper which they save.

The ordinary motor for simple alternating currents has the great drawback that it will not start itself. When running it must be kept in perfect synchronism with the generator supplying it, the result of which is that when overloaded it comes to a dead halt, sometimes with disastrous results. The only way it can be used is, therefore, to start it by some independent means and bring it up to the required speed before we turn on the current; the load can only be applied after this has been done. In cases where only one motor is to be supplied from the line, and the load is a constant one, the system can be used to advantage. A notable example, and the only one of which we know, is the mining plant at Telluride, Colo., installed by the Westinghouse company. A potential difference of 8,000 volts is used, and 120 h. p. are transmitted 2¾ miles at an efficiency of 75 per cent. This plant, we believe, is doing its work well; its total primary cost is given at $100 per horse power delivered.

Mr. Tesla, some years ago, brought out a new form of alternate current motor which has, however, as yet, not been put to practical use. The principle involved is quite simple. Take *e. g.*, a four pole machine and excite the field by means of two separate alternating currents, opposite poles being wound on the same circuit. If we give to these currents a phase difference of 90 degrees, they will produce a resultant magnetic field which will rotate with the same periodicity as that of the exciting currents. Mr. Stanley has lately devised a motor on which he uses a condenser to neutralize the effects of self-induction, and also a method by which he claims the Tesla motor can be used on any simple alternate current circuit. Still another new form is that of Ganz.

As to the merits of the tri-phase alternating current, it possesses the same advantages as the simple alternating current in that it can easily be changed to any desired voltage by step-up and step-down transformers. The system received its first great trial at the Frankfort Electrical Exhibition in the summer of 1891, when the energy of a water-fall was transmitted from Lauffen to Frankfort, a distance of 108 miles. The underlying principle is the same as that of the Tesla motor.

The first named type of tri phase motors, like the synchronous, simple alternating motor, must harmonize in phase with the generator; it is, therefore, not necessarily self starting, though it will start with the generator. Its fields must be excited by continuous currents. The second type will start itself, even under heavy load, and of course requires no separate field excitation; its speed is also fairly constant under variations of load. THE ELECTRICAL WORLD of Jan. 21, 1893, contains a very interesting table of efficiency and other data for small machines of this class, compiled by the Oerlikon Company, of Switzerland. With this motor the tri-phase system should be quite as commercial for central station distribution as the continuous current. Moreover, by means of specially designed motor-dynamos, it can be transformed into continuous currents of any desired voltage. We could thus transmit energy from a large and otherwise inaccessible source over a considerable distance and supply current either alternating or continuous at any desired potential difference and for any desired purpose.

Summing up then: Of the different systems now in use for the transmission of energy, in cases of any considerable distance the electrical methods make undoubtedly a better showing in point of efficiency than any of the purely mechanical methods and they have also much the advantage in first cost. So soon as the distance exceeds a few miles the low tension current of course drops out of consideration. For moderate distances, not over six to eight miles, we think continuous current apparatus will generally be found the most suitable. If we want to supply a number of large motors, each with varying load, the problem will be difficult, but it will be so in any case. For long distances the tri-phase current is, we think, at present the most suitable and there are many instances where large water powers now going to waste could thus be utilized.

* Abstract of a paper read before the Canadian Electrical Association at Toronto.

Underground Construction *

BY W. A. TOWER.

It is only within the last seven years that underground conduits for electrical purposes have been constructed to any extent, although as early as 1808 Soemering, a Russian scientist, exploded mines electrically through an underground wire a mile long, and in 1837 Cooke and Wheatstone operated the first practical telegraph system in the world by means of underground wires.

The first work of burying wires in America was done in Washington, D. C., but I believe the system did not work satisfactorily, and is to be, or has been, remodeled. The next work of any importance was done in Chicago, where they adopted the drawing-in system, the only practical system for telephone work at the present time.

This system does not necessitate the use of any particular material or make of conduit, of which there are a great many. The principal ones are: 1st, iron pipe, 2d, cement-lined iron pipe, and 3d, the Wyckoff.

In building an iron pipe conduit, after the trench has been dug, a layer of concrete about three inches thick is laid, wide enough to allow an inch or more between each pipe, and three inches on each side. A row of pipes is then laid, the pipe lengths varying from 14 to 22 feet, and are screwed together by regular threaded couplings. After this is done concrete is put on, filling up the spaces between the pipes and the three inches on each side. The concrete is then leveled off about one inch above the pipe. Another row of pipe is then put down, and the process repeated until the proper number of ducts has been laid. The top layer of the pipe is then covered with three inches or more of concrete, and the trench filled in.

The cement-lined pipe comes in lengths of about 8 feet with beveled male and female ends, and is laid in the same way as the iron pipe. The joints are made by bringing male and female ends together, and covering the junction with neat cement.

The Wyckoff conduit consists of pieces of thoroughly creosoted wood, about 8 feet 4 inches long, 4½ inches in diameter, with a three-inch hole through the centre, the ends counter-bored and tenoned. There is first laid an inch-and-a-half board in the bottom of the trench, which is wide enough to hold the proper number of ducts. The ducts are then laid on this, layer by layer, the joints being made by joining the male and female ends about half the length of the tenon, when hot pitch is poured in, and the lengths then driven together. After the ducts are all laid, a 1½ inch board is placed on top to protect the ducts from the picks of workmen digging across the line of the conduit.

This all appears very simple to those who have had no experience with this work, but some of the difficulties which have to be overcome are by no means trifling. In the first place, after deciding upon the route to be followed, it is necessary to find out whether there is room enough on the street to lay the conduit. The engineer or superintendent of construction applies to the city and gas company for the location of their mains, which information, as a rule, is given very graciously, but in three out of five cases the position given is not correct within two or three feet, and about the only use made of the information is to tell on which side of the street the mains are, and, consequently, test holes have to be dug to locate the pipes before the work can be started. As a general rule the bottom of the conduit is put below the level of the gas mains, and when a corner is reached it is often necessary to carry part of the ducts over the mains, and part under them. The manholes are usually located at street intersections, and consist of chambers about 7 feet long, 5 feet wide, and 7 feet deep, with brick walls laid in cement, and a cast iron head and cover generally made to bolt down tight to keep out water. After the conduit is laid and manholes built, an entrance must be obtained to the telephone building, which too often has been built without proper consideration for the handling of cables.

In pulling in cables, we first have to get a rope through the duct. This is done with wooden rods, about four feet long, equipped with malleable-iron couplings. The rods are handled quite easily, two men being able to rod 400 feet of conduit in about 15 minutes. The rope is fastened to an iron clevis, about 10 inches long, made to fit the cable, and riveted on to the end of it. The reel of cable being on a holder, the cable is then ready to pull in, which is done with a winch geared to an upright shaft with a sliding drum, and so arranged that the drum can be placed exactly opposite the duct through which the cable is to be drawn, thereby avoiding pulling the cable around, or over any corners of the conduit.

After the cables are in, the splicing has to be done. This operation requires the greatest of care, and only thoroughly reliable men should ever be employed to do this work. In making a splice, the cables from each way are bent into their proper places in the manhole, and then cut to the proper length, which allows the ends to lap about a foot. The lead is then stripped off each end the length of the lap, and a piece of lead pipe, large enough to cover the wires when spliced, is then slipped over one of the ends; the wires are separated in pairs and turned back as far as the lead is stripped.

Two pairs of the bottom wires—one from each end—are then taken, and the insulation stripped off, care being taken not to nick the wires. A paper sleeve is then put on one end of each wire, the wires twisted together, and the sleeve slipped back over the junction of the wires. After all the pairs are joined in this way, they are boiled out with hot paraffin, to vaporize any moisture that may have been absorbed while making the splice. A piece of paper is bound around all the wires to keep the paper sleeves in position; the lead sleeve is now pulled over the splice, and a regular plumber's joint wiped.

Before a splice is started the cable is tested back to the office, or to the point from which it starts for open and grounded wires; the length to be spliced on is also tested in the same way, and if any such wires are found they are spliced together, so that although there might be a faulty wire in every section of the cable there would still be only one bad wire from end to end. If the testing were not done, a faulty wire in one section might be spliced to a good wire in the next, and so on; in which case the more sections of cable the more faulty wires there would be in the entire length. After all the splices are made, and the pole or building terminal put on, the wires are tested out and put on corresponding binding posts at each end. A capacity and insulation test is made, and if it is up to the standard the cable is ready for use. At present the insulation must be at least 500 megohms per mile, and the capacity at most .08 microfarad per mile.

* Abstract of a paper read before the Canadian Electrical Association at Toronto.

The Incandescent Lamp.*

BY R. G. BLACK.

Admirable as is the system of arc lighting for use in streets or large halls, it is entirely unfit to take the place of the numerous lights of moderate intensity employed for general domestic illumination. For this purpose it was at a very early period perceived that the luminosity of a continuous conductor by an electric current was the most promising method.

The first material which was though of in this connection was platinum, or one of its allied metals, such as iridium, which have the highest melting point among such bodies, and are, besides, entirely unacted upon by the air at all temperatures. In 1848, W. E. Staite took out a patent for making electric lamps of iridium alloys, shaped into an arch or horseshoe form.

In 1845 a patent was taken out by Mr. J. W. Star, of Cincinnati, for an incandescent lamp, the important parts of which are a platinum wire sealed through the top of a small glass chamber constituting the upper end of a barometer tube. This platinum was clamped to a thin rod of carbon, supported by a non-conductor and connected by a wire to the mercury below.

Other inventors, as for example, Konn, of St. Petersburg, continued to work with rods or pencils of hard carbon, but achieved only a limited success. This was the state of affairs even up to the fall of 1878, when, as it is claimed, Mr. William F. Sawyer, in combination with Mr. Albon Man, after many preliminary experiments produced a successful incandescent lamp, with an arch-shaped conductor made of carbonized paper.

It is to Mr. Thomas A. Edison, without doubt, that we owe many of the simplifications and modifications which, by cheapening the lamp and diminishing its weight, have extended its range of use and its usefulness to a remarkable degree. Like many before him, he first turned his attention to platinum and platinum alloys, and devised a form of lamp admirable for its simplicity, but unfortunately open to many fatal objections. During the year 1878, however, Mr. Edison was most diligently at work, and turned his attention to carbon in its various forms, finding fibrous textile material when carbonized to be the most convenient.

The carbon filament is the all-essential part of the incandescent lamp. So important is it that the manufacturers have tried almost every conceivable substance. Although many good hair filaments are made, vegetable fibre seems to be the most preferable substance for carbonization. This process, although most sacredly guarded by the different manufacturers and varying vastly in detail, is in general as follows: The substance to be carbonized, whether paper, cotton or bamboo, is cut by a machine into delicate strips, which are collected in small bundles and bent so as to lie in "U" shaped grooves in graphite plates. These, packed with graphite powder, are placed in large black lead crucibles, carefully closed and heated, in a Siemens furnace, to an intense white heat; after cooling the crucibles are opened and the new carbonized filaments, looking like delicate wires or threads of steel, are removed. They are now of the curved shape into which they were bent before carbonization, but are quite elastic and strong. There are various after treatments, such as subjecting the carbons to a plating process, or treating in a vacuum with hydrocarbon, etc.

The incandescent lamp, which is fortunately restricted to the use of an incandescent filament, placed in an exhausted globe, which does not require any regulating mechanism, allows of a difference only: 1. In the choice of the raw material from which carbon filaments are made. 2. In the treatment of the raw material before and after carbonization. 3. In the length of the filament and its cross section. 4. In the mode of connecting the filament with the current conductor, or platinum wires, respectively, which join it to the leads. 5. In the more or less perfect exhaustion of the lamp bulb.

All incandescent lamps, with the exception of the Cruto and Bernstein lamps, employ a vegetable fibre of some kind as raw material for preparing the filament. Edison considers the fibrous structure of bamboo advantageous for obtaining a tough filament of high mechanical resistance; while Weston, on the other hand, subjects the cotton fibre to a process which entirely deprives it of its structural character and transforms it into amorphous cellulose, for which he likewise claims great toughness and mechanical resistance. We know that excellent results have been obtained with both these filaments, from which we may safely draw the conclusion that the nature of the raw material is of little consequence as long as it is of a thoroughly homogeneous character.

Until quite recently it has been the object of lamp dealers to procure long-lived lamps, thereby reducing the expense of renewals, hence being better able to compete with other illuminating agents. It was found that, although these lamps lasted several thousand hours, they require considerable current, therefore they were not very economical. The aim of lamp manufacturers now became to obtain the greatest number of lamps per horse power, that is, to get the greatest amount of light for the least expenditure of energy. To do this the filaments were made longer and finer, and by the after process of carbonization the resistance was considerably raised. From these and numerous other causes the different types of lamps range in efficiency from two and even as low as one and a half to six watts per illuminating candle power. Recent elaborate tests go to show that although a lamp may commence with a very high efficiency, say at two watts per candle power of light during the first 200 hours, it is likely to decrease uniformly to seven or eight candle power, thereby only having an efficiency of five or six watts per illuminating candle power. After this point the falling-off in candle power and efficiency is not so marked, but continues until the carbon is at last consumed.

Taking all facts into consideration, it would seem, according to our judgment, that the best lamp to procure for station work is one of moderately high economy, say of about 3.1 or 3.2 watts per candle power of light.

It is a well known fact that the efficiency of an incandescent lamp increases very appreciably the more it is forced, that is, the number of watts required per candle power of light becomes less the greater the voltage to which it is subjected. It is also well known that on the other hand the life diminishes very rapidly the more a lamp is thus forced.

Having decided upon the best lamp to use, the next thing to obtain is an absolutely steady current. A precisely even potential is one of the most essential requisites for obtaining any sort of satisfactory results with incandescent lamps. We would most emphatically recommend that a man be detailed in every large plant or station to watch the pressure indicators and regulate the current accordingly. Also that the station be provided with a good portable voltmeter, so that the potential may be known at different points.

* Abstract of a paper read before the Canadian Electrical Association at Toronto.

A Gem from the Lay Press.

"The governor of the electric light works in Sedalia, Mo., broke the other night and the engine jumped from 500 to 2,000 volts. The globes burst in the street cars and there was great excitement for a while."

There would seem to be no cause for excitement in this simple fact, but the state of affairs would have been quite different if, for instance, 500 engines had jumped 2,000 street cars and the globes had burst the volts or if 2,000 governors had jumped the engine and the Sedalia electric light works had gone broke, or if something else of this kind had happened. While it was certainly undignified in the engine to have jumped 1,500 volts because the superintendent or governor of the station broke the night, it implies an ignorance of electricity on the part of the editor to have given the matter such prominence.

Railway Train Electric Lighting in France.

Several attempts have already been made by the Paris Northern Railway Company to substitute electric lighting for the oil lamps now in use. After a few successful trials, fresh experiments have just been undertaken on a larger scale. Underneath each carriage were placed cases containing 16 accumulators, supplied by the Societe des Metaux, each containing nine plates, the total weight of which is 8.1 kilogrammes. The total weight of the battery, including the cases placed under the carriages, is 390 kilogrammes. Each kilogramme of plates giving a capacity of 14 ampere-hours, we may reckon upon a total capacity of 115 ampere-hours. The lamps used are 10, 8, and 6-candle lamps; they require a difference of potential of 30 volts, with 3 watts per candle, and only last from 250 to 300 hours. For a first-class carriage the cost of establishment amounts to 725 francs. This expenditure is made up as follows: Accumulators, 462 francs; cases, 120 francs; cables, 65.8 francs, and fittings, 77:2 francs.

Ether and Electricity.—Part II.

BY A STOLETOW.

Penetrated with this idea of Faraday's, to which he gave a mathematical form, Maxwell proposed his "Theory of the Electromagnetic Field."

To give the topography, so to speak, Faraday and Maxwell traced in the electromagnetic field the lines of force. If we follow, leaving at any point, the direction of the magnetic force, we trace a line of magnetic force; likewise, we may trace a line of electric force. We find that the lines of electric and those of magnetic force cut each other at right angles. The field is thus divided into zones or tubes of force. We might construct these tubes of force so that their density (the number of lines of force passing the unit surface of section of the tube) shall at each point of the field be proportional to the intensity of the force.

In the electrostatic field each line of force may be said to commence in a point which possesses a positive charge and to end in one charged negatively and, since there are neither electric forces nor charges on the interior of conductors, we find no lines of force there.

Near a wire which completes the circuit of a battery, the lines of electric force are parallel to the wire, but the lines of magnetic force are in rings around it, along its length. This simple fact had in Faraday's eyes a deep meaning. To him the substance of the magnetic field is a complex mechanism of which the parts are all bound together, and which recalls not the planetary system of Newton, in which the centres of force act at a distance without the intervention of surrounding medium, but rather a reservoir containing water with bodies submerged, where every movement is propagated in all directions and manifests itself, more or less, in all parts of the medium.

In a purely mechanical sense, apparent force is not the proof of action at a distance; it might result from local action or from that of the surrounding medium extended over considerable space. A whirling body is under the action of centrifugal force. All its parts are driven from the axis of rotation. A top preserves its upright position as long as it spins; there is a force which prevents it from falling, though it falls when it stops. Here the quasi-forces are produced in the very act of turning. They do not exist when the top is at rest. A light body floats on the surface of water; a balloon rises in the air. Are they driven away by the earth? Of course not. The source of this power is in the surrounding medium; every particle of compressed air or water possesses a certain energy, and it is this which is manifested in the rising of the body. In the excellent experiments of Bjerknes, bodies plunged in water have mutual reactions which recall very closely the play of electric and magnetic forces. If we communicate to these submerged bodies very slight and very rapid motions—oscillations and pulsations—it is easy to see that the surrounding water feels also the same oscillations. The reciprocal actions that we notice between submerged bodies have for a source the energy of the slight motions which have been communicated to one body and then transmitted to the surrounding medium.

We would have believed a theory quite artificial and insufficient if in all the phenomena that we have just noticed we had concentrated all our attention upon the visible attractions and repulsions without taking into account the motion and deformation of the medium, in which the true explanation of these phenomena is to be found.

Can we not regard the magnetic field in the same manner? Could its polarity not result from molecular polarity? It is proved by the division of magnets that each particle of one is a magnet.

We might regard a tube of force (electric or magnetic) as a series of polarized molecules along a line of force and united with their opposite poles together. But this is not all. What is the polarity of a molecule? Each molecule is electrified or polarized, and its mechanical action in this complicated electromagnetic field must result from the mechanical state of the molecule itself, from its deformation and its own real movement.

Faraday has already represented each tube of force of the electromagnetic field as stretched along its length and pressed on its sides by neighboring tubes; or, in other words, that each molecule which is polarized tends to contract in the direction of the line of force and to swell transversely.

Maxwell has shown that this idea of the electromagnetic field corresponds exactly with what actually happens. Such an idea of the electromagnetic field, however far it may be from perfect clearness, still renders us immense service. But we notice first that it is in direct contradiction to the popular ideas of the action of conductors and insulators.

Take, first, electrostatic phenomena. We are accustomed to speak of "charged conductors," although we have known for a long time that the charges are borne upon the surface of separation of the conductor from the surrounding air or some other dielectric (generally, on the surface of separation of two dissimilar bodies). Conductors do not contain lines of force. These lines traverse only dielectrics; they stop at the surface of a conductor. Like Maxwell and Faraday, we must attribute all the electric energy to the dielectric, all these molecular perturbations by which we explain the properties of the electromagnetic field. The conductor appears then as a part of space where this form of energy cannot penetrate, and instead of saying that a conductor is charged we must say that the surrounding air is charged.

It is not difficult to see that such a conception has a very large physical probability.

The interior of a conductor when electrified undergoes no change of temperature or of molecular structure.

It is of no importance what the conductor is made of; a conductor of platinum and one of aluminium having the same dimensions and the same form will receive the same charge if they are placed in contact with the same source of electricity, and their electrostatic actions will be exactly the same. But we observe a different phenomenon when we examine the surrounding insulator. The electric forces vary if we replace air with another gas; they vary still more if we replace air with a dielectric liquid or solid (sulphur, paraffine, glass, etc.). Finally, direct experiment shows that the electrical forces produce tension and change of structure in a dielectric; the glass of a Leyden jar becomes thicker; glass and even dielectric liquids present under the action of electrical forces the phenomenon of double refraction like some crystals.

All these facts prove that in electrostatic phenomena the exclusive function belongs to the dielectric medium. Now a vacuum can play this role of medium; it also transmits electrostatic force, for we know that this so-called vacuum is full of a special substance called ether.

So, then, we see the principal action in dielectrics comes from the imprisoned ether and conductors are bodies on the interior of which ether loses its property of electrically polarizing itself. This is how we establish the first relation between electrical phenomena and those of radiation.

This same medium, free ether or ether of transparent bodies, appears as the vehicle of these two forms of energy. Indeed the greater part of insulators (air, paraffine, glass, etc.) are bodies more or less transparent with reference to these two kinds of vibrations. Metals are the best conductors and are opaque; they are as impenetrable to light as to electrical energy.

Let us now take the electromagnetic field produced by an electrical current. Here again we are in contradiction to the popular idea, for we had been accustomed to regard the conducting wire as a canal on the interior of which the electricity flows. But if we cease regarding electricity as a material substance this phase can have only a conventional meaning, as one speaks of the movement of a wave, of heat, of energy. Each of these symbolic expressions always supposes a real movement; in the case of the electric current there should be some movement of matter, the current being a kinetic phenomenon.

Direct experiment (Rowland) has shown that in moving a body charged with electricity we awaken magnetic forces in the surrounding medium; the visible movement of matter in this case acts like an electric current. The property of turning the plane of polarization which the current possesses (Faraday's experiment) shows also according to Thompson that the current is a kinetic phenomenon.

But the words—electricity flows in a wire or the current circulates—do not indicate what the substance is that moves, what is the means of such motion, nor how this motion is propagated. The electric current is a change in the electrostatic polarization of the field, and this change is accompanied by a magnetic force. In the discharge of a Leyden jar an instantaneous current destroys the electrical condition of it; in a continuous current from a galvanic battery a continuous discharge is accompanied by a new and continuous charge.

In admitting that electrostatic phenomena represent the molecular energy of ether, we must regard the electromagnetic field as the place of currents of this energy of ether. The distribution of the lines of force must indicate to us the position of this energy and the lines of its transmission. In following these indications we must attribute the electromagnetic energy to the ether of the conductors (of the circuit) and to the ether of the surrounding medium (the air). This is Maxwell's opinion.

One of his pupils, M. Poynting, indicates in a clearer manner the function of conductors. I will give to his ideas the greatest emphasis.

Metallic conductors are the destroyers, the extinguishers of electromagnetic energy. In the homogeneous metallic conductors of an electric circuit heat is developed; this heat is their part of the energy. But this heat is no longer the particular form of electromagnetic energy we find in the surrounding medium. No experiment has yet shown that the current produces any other effect upon metal than the elevation of its temperature; some effects observed in wires (variation of elasticity, elongations, etc.) can be traced to the action of heat. . . . The function of the metal as an extinguisher of energy becomes especially clear when we study alternating currents. These currents do not penetrate the interior of the metal. They are extinguished at a depth as slight as the alternations of the current are rapid. . . .

The recent experiments of M. Hertz on alternating currents have shown directly that they pass through a very thin metallic shell (1-20 millimetre thick) and no deeper. Even less rapidly alternating currents of dynamo-electric machines pass along the surface of the conductor if it is thick enough; thus in a copper wire of 10 centimetres diameter, the density of a current of 80 alternations per second becomes seven and a half per cent. at a depth of one centimetre and the apparent resistance is almost four (3.8) times as great as with an ordinary current. As air and down and the like are non-conductors of heat, so metals are non-conductors of electromagnetic energy. M. Pointing claims that the energy of a voltaic current is propagated in the dielectric medium, ordinarily the air; so the line of this propagation forms a right angle with the lines of electric and magnetic forces. Partly, this energy glides, so to speak, along metallic surfaces; partly goes through the surrounding medium, and meeting a metal penetrates to different depths, changing into heat. So, contrary to present ideas, the propagation of electricity in telegraph wires is made in the air; and in subterranean cables, in the insulation of the cables, or more exactly, in the ether of these insulators.

A conductor making the circuit is necessary to obtain a current, but its function is not what was formerly supposed. The conductor is necessary to absorb the electromagnetic energy; without its aid an electrostatic equilibrium would be established. But it destroys this equilibrium by absorbing energy continuously and transforming it into heat. Thus it causes a new activity in the source (the battery), keeping up this continued flow of electromagnetic energy which we call current. It is true, from another point of view, that the conductor directs, so to speak, and collects this energy, making it travel along its surface, and in this way only it justifies its traditional name.

The function of a conducting wire reminds us of the wick of a lighted lamp in some respects; the wick is indispensable but it is not that that is the source of the chemical energy, but rather the combustible matter that surrounds it; the wick is the place of the destruction of the combustible substance. It draws up continually its supplies, and supports thus a gradual and continued transformation of matter into heat.

(To be continued.)

* Translated from the French by Lieut. William W. Hartz, Corps of Engineers, U. S. A. For the first section of this article see THE ELECTRICAL WORLD of Jan. 28, 1893, page 62.

Electrical Needs of the Times.

BY MR. LEWIS T. ROBINSON.

In the issue of The Electrical World of Jan. 21 I notice a communication from Mr. Watts in which he seems to consider my purpose in criticising his remarks on transformers somewhat differently than was my intention.

My only purpose was to call Mr. Watts' attention to the fact that in his discussion of the subject of lowering the frequency of alternators he should not fail to consider the increased weights or losses in the transformers.

This being the case, I could hardly do otherwise than confine my remarks to that portion of the article which dealt (or rather failed to deal) with this branch of the problem.

Mr. Watts again believes that the changes pointed out by me would be less than I suppose. I have not the opportunity to prove my statements by actual tests on the frequency mentioned, but consider deduction based on well proved and generally accepted laws to be correct.

The law relating to the variation of hysteresis loss with the induction and frequency has been well proved by Mr. Steinmetz, the discoverer; and, while it adds nothing to say it, I have myself found the law to be very approximately correct.

Referring to the first case mentioned by me, if the transformer was not constructed to run on a low induction (or to have a large mass of iron) the primary would disappear in smoke, and, at any rate, the increased constant, primary and eddy-current losses would operate to make the total loss more than stated by me.

If the transformer performed satisfactorily on 35 frequency the mass of iron contained would be larger than necessary for 100 frequency or the losses would be correspondingly reduced.

I did not pronounce 60 or even 35 frequency impractical or certainly not out of the question, simply showing that the transformers for use on the same must be either larger or less efficient or both.

The fact that the increased primary currents could not be detected by ordinary station instruments, if it is true, is a reflection on the instruments and nothing else, as I hardly think that Mr. W. wishes to consider the time and thought given to raising the transformer efficiencies in the last few years, say 5 or 6%, to be thrown away even provided these instruments cannot detect it.

Regarding the remainder of Mr. W's article, which from its nature I judge was not called forth by my remarks, I can only say again that I am well aware that a low frequency may be of advantage to all parts of the system save the converter, and may even outweigh the increased sizes or lowered efficiencies in these.

In concluding, let me ask Mr. W. not to cling to ideas having no foundation in fact; but, while he may favor a low frequency system of distribution, let him not fail to face the converter side of the problem squarely and in conformity with well proved laws and experiments.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Electrostatic Motion.—A very interesting article by Mr. Arno, of Turin, in the "Elektrotechnische Zeitschrift" explains some experiments with a new form of static motor, based on the action of a rotating electric field and electrostatic hysteresis. He begins by describing the well known experiment of Prof. Ferraris of electrodynamatic rotation produced by electric currents of different phases, and states that the present apparatus is quite similar in principle except that the magnetic forces are replaced by electrostatic forces and the magnetic body by a dielectric body. That electrostatic hysteresis exists was known before the researches of Mr. Steinmetz. Owing to this property he says rotation can be produced by means of an electric field similar to that produced by a magnetic field. He explains the principle of the action in the Ferraris experiment due to two varying magnetic forces at right angles to each other, and shows that similar rotations may be expected from two varying electric fields at right angles to each other. If these electric forces vary according to the sine law and differ by 90 degrees the rotations will be uniform. To show this he constructed the following motor: A short, open, metallic cylinder was cut longitudinally into four sections insulated from each other; two of these, opposite to each other, were connected to one source of electrostatic potential and the other two to a second source, the two sources generating alternating potentials differing in phase, as described above. Inside of this open cylinder was suspended a small cylinder of mica. When the electrostatic field was generated this cylinder rotated, the direction depending on the direction of rotation of the electric field.

For generating these alternating potentials the following arrangement was used. An alternating current was passed through the primary of an ordinary Ruhmkorff coil, the secondary current of which passed through a very high inductionless resistance, which we will call R, in series with a condenser which we will call C, the capacity of which may be very small. From the ends of the resistance R two wires lead to two opposite quadrants of the motor, and from the poles of the condenser two other wires lead to the other pair of quadrants. As is well known the voltage at the terminals of the resistance will have the same phase as that of the current, while that at the condenser will differ from it by 90 degrees. The quadrants of the motor will, therefore, be charged with alternating potentials differing in phase by 90 degrees. A mercury commutator serves to change the relative polarities of two of the segments of the motor, which changes the direction of rotation. By varying the resistance R and the capacity of the condenser, it is easy to obtain such conditions that the voltages are equal to each other in amount. The rotating cylinder may also be made of paraffined paper, glass, ebonite, wax or other insulating materials.

Another motor was constructed in which the revolving cylinder was made of ebonite weighing about 40 grams and supported on steel pivots and glass bearings. The stationary split cylinder was about 8 inches high and 4 inches in diameter; the movable cylinder was about 7 inches long and 3⅛ inches in diameter. The condenser was made of a common beaker glass 1 millimetre thick, with tinfoil on the outside and mercury on the inside; its capacity was .0003 microfarad. The resistance R was made of a column of water 3.5 millimetres in diameter, the length of which could easily be varied; in the experiments its length was about 21 inches and its value was 13.5 megohms. The frequency was 40 and the potential was 3,800 volts. The cylinder started by itself and in several minutes obtained a speed of 250 revolutions per minute. The torque was measured statically by a bifilar suspension and found to be 176 C. G. S. units. He suggests that this experiment enables one to show the existence of electrostatic hysteresis, and to study its action quantitatively. The illustrations accompanying the original article show the electrical connections of the whole apparatus and give diagrammatic representations of the motor.

High Frequency Discharges.—Referring to the experiment of Mr. Swinton with high frequency electric discharges (see The Electrical World, Jan. 23, page 64) Prof. Elihu Thomson describes in the London "Electrician" some similar experiments of his own. He states that he noticed a similar phenomenon in his early working with his apparatus. The filament itself was thrown from its support around in the bulb and bits of the filament moving about in the bulb were brought to brilliant incandescence; this was generally followed quickly by the breaking of the bulb and the complete destruction of the lamp. In placing an ordinary filament without a globe in the line of discharge the spark passed through it and produced the same brilliant incandescence. He came to the same conclusions as Mr. Swinton that the current was only on the surface. His experiments were conducted six months ago. Referring to the 64-inch discharges (mentioned editorially in The Electrical World of Dec. 17, 1892) he said: "The sparks took the form of a torrent, resembling in the most striking way lightning flashes, and they were accompanied by enormous developments of ramifying sparks in all directions from the electrodes. The development of ozone in the neighborhood of the apparatus during the passage of the discharge is so great as actually to be very disagreeable and irritating. I think it quite possible that apparatus of this kind may be found useful in the artificial production of ozone. Our experience shows that these high frequency discharges are not by any means harmless, as it was found that a kitten placed in the path of the discharge was instantly killed. While, no doubt, for some reason or other, an increase of frequency may lessen the danger to life, as shown by the experiments of Dr. Tatum, there is no certainty but that at some still higher frequency increased danger may exist, and for the present at least we must come to the conclusion that wherever high frequency currents have apparently been harmless there has simply not been enough current to do any harm."

Continuous Alternating Transformer.—Prof. Elihu Thomson states that he has operated with one million alternations per minute, and has built a machine capable of giving over two million alternations per minute, but considers it of little value because he has since devised a plan, not yet ready for publication, whereby a continuous current is, by purely electrical processes, made to give alternating currents of any desired frequency, which frequency can be governed to cover almost any range by very simple means. It has no moving pieces whatever.

MAGNETISM.

Joints.—Mr. Meylan in "L'Electricien," reviewing the subject of the influence of joints in magnetic circuits, makes some deductions of practical interest from the researches of Messrs. Ewing and Low. He states that the effect of joints is a matter of small importance in all cases where there is a considerable air space included in the magnetic circuit, as for instance in all dynamos. But on the other hand the influence of joints is by no means negligible in closed magnetic circuits, as for instance in transformers. From the Ewing researches he shows that a joint reduces the permeability from 7 to 25 per cent., depending on the induction. The effect of a joint made as perfectly as possible is, therefore, equivalent to about .035 millimetre of air; the air space in the usual forms of dynamos is from 7 to 15 millimetres and the effect of four joints in the magnetic circuit, therefore, is equivalent to increasing the air space only about one to two per cent., remembering that the intensity in the cores is about double that in the air space. To correct this, therefore, requires an increase of excitation of only one or two per cent., but as the total excitation is only a small per cent. of the total output of a machine, it will readily be seen that the effect of the joints in a dynamo is insignificant. The very great care taken by some makers to have very perfect joints is, therefore, not justifiable.

In transformers, however, the question is quite different. He states that if the joints could be avoided a gain of 10 to 15 per cent. in the magnetizing current could be obtained; but it is evidently practically imposible to make transformers without magnetic joints. He speaks of the well known Ferranti transformers, in which the joints are practically avoided by overlapping, but in this arrangement currents are induced to flow in the direction of the sheets, which is, therefore, a disadvantage. In the usual transformers the real depth of the air space at the joints depends upon many circumstances, and it is probably much larger than the theoretical thickness deduced by Ewing. The question of joints is, therefore, a very important one in the design of transformers and should be very carefully studied. To do this, he proposes to find the magnetic curve of a transformer and afterward that of samples of iron sheets taken from the same stock. A comparison between the two will show the effect of the joints. In testing samples he states that considerable errors may be produced by the joints which necessarily exist in all apparatus for testing samples, and he calls special attention to avoiding the effects of these joints as much as possible, as is done for instance in the apparatus of Hopkinson. In conclusion he says that while the predetermination of the characteristics of dynamos is of real value because the air space renders the other joints insignificant, the predetermination of the characteristics of transformers having a closed circuit is very uncertain and probably of little practical value.

Dr. Wassmuth has investigated analytically the subject of how far the idea of magnetic resistance is justified in the case of an open magnetic circuit made of a ring with an air space, and wound completely and regularly with wire. He obtains the following approximate formula:

$$N = \frac{4\pi S i}{\frac{l}{K R^2\pi} + \left(\frac{2\pi k l}{K^2 R}\right)\frac{\lambda}{R^2\pi}}$$

in which N is the number of lines of force, i is the current, S the number of windings, l the mean length of a winding, $R^2\pi$ the cross section of the core, λ the length and $R^2\pi$ the cross-section of the air space, $K = 1 + 4\pi k$, the coefficient of magnetic permeability. He states that in the formula it will be noticed that there is a term in the denominator which is proportional to the length of the air space divided by its cross-section, and which can be taken as the magnetic resistance of the air space. Furthermore, that the part in parenthesis differs from unity, which explains the scattering of the lines of force at the air space

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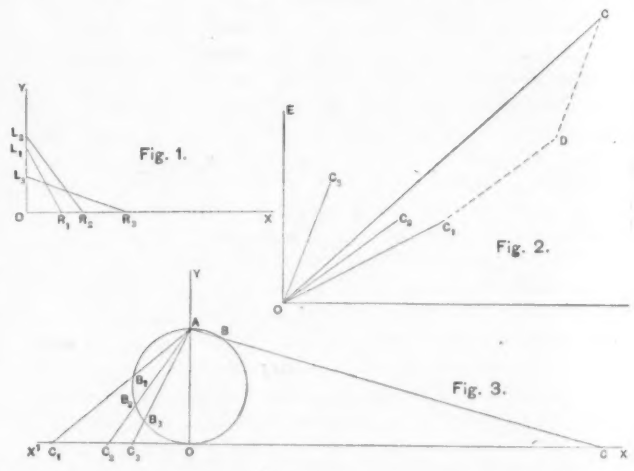
Mr. Berget stated at the French Society of Physics that a bar of iron 52 millimetres long elongated .000255 millimetre in a magnetic field of 40 C. G. S. units, .000467 millimetre in one of 150 units, and .000562 millimetre in one of 540 units. Bismuth has no perceptible elongation, a fact also noticed by Van Aubel.

Mr. Holborn, in a report of the German Physical Institute, states: Steel lessens its magnetic susceptibility if tempered at too high a temperature, on the other hand the coercitive force is not diminished if the magnets are tempered at the temperature at which magnetization obtains its maximum.

UNITS, MEASUREMENTS, INSTRUMENTS, ETC.

Impedance of Branched Circuits.—Mr. Russell in the London "Electrician" gives the following simple graphical method: The ordinary algebraical formula for giving the solution of this problem is complicated and unsuitable for arithmetical calculation. The impedance can, however, be calculated graphically without much difficulty, and the method is instructive, as the final figure shows at a glance the relative phases of the various currents. Suppose that there is no appreciable mutual induction between the coils, that their coefficients of self-induction are constant, and that the applied E. M. F. follows the harmonic law. Let the coils, which are all placed in



parallel, have resistances R_1 R_2, . . . and coefficients of self induction L_1 L_2, . . . and let the applied E. M. F. be $E \cos p\ t$, where p is equal to 2π multiplied by the frequency.

The instantaneous value of the currents before division is equal to the sum of the currents after division. We know, therefore, that the main current follows the harmonic law, and that its value is found by a theorem which is exactly analogous to the method in statics of compounding forces into a single resultant by the polygon of forces.

In order to get lines proportional in length to the currents we have first to construct lines equal to the impedances, $\left\{R_1^2 + p^2 L_1^2\right\}^{\frac{1}{2}}$. . . Draw two lines (Fig. 1), $O X$, $O Y$, at right angles to one another, and make the lengths $O R_1 = R_1$ . . ., $O L_1 = p L_1$ . . ., and join L_1, R_1 . . . Then the lengths of the lines $L_1 R_1$, . . . give the impedances of the various coils, and the angles α, β . . . give the lag of the currents in the coils behind the applied E. M. F.

In Fig. 2 take any point A in $O Y$, and on $O A$ as diameter describe a circle, $O A$ being greater than the largest impedance. Draw chords $A B_1$, $A B_2$ . . . equal in length to $L_1 R_1$, $L_2 R_2$ . . . and produce these lines to meet $X X^1$ in C_1, C_2 . . . Then $A C_1$, $A C_2$ . . . are proportional to the currents in the coils.

Now make the angles $C_1 O E$, $C_2 O E$ . . . in Fig. 3 equal to α, β . . ., and make the lengths $O C_1$, $O C_2$ . . . equal to $A C_1$, $A C_2$ . . . in Fig. 2. From C_1 draw $C_1 D$ parallel and equal to $O C_2$, and from D draw $D C$ parallel and equal to $O C_3$, and so on if there are more than three branches; join $O C$. Then $O C$ is proportional to the current before subdivision. The lag of the current $O C$ behind the E. M. F. is obviously the angle $C O E$, and the difference of phase between the various currents can be measured from the figure. To get the joint impedance, make $A C$ (Fig. 2) equal to $O C$ (Fig. 3), and let it cut the circle in B. Then the length of $A B$ is the resultant impedance.

The above method is also applicable to cases where there are condensers in the circuit, by considering a condenser as a resistance coil.

Mr. Whitwell, in the Lond. "Elec. Rev.," discusses mathematically the subject of alternating currents in a divided circuit. His conclusions are as follows: In the simplest case in which there are only two branches we may say that the equivalent in impedance of two conductors in parallel is equal to the product of their impedances taken singly divided by their impedance when in series. To find the fraction of the total current which flows in one branch of a simple divided circuit when the currents are all direct, we divide the total resistance by the resistance of that branch. Similarly in the case of alternating currents if the maximum value of the total currents is C the maximum values in the branches will be $C\frac{l}{\alpha}$ and $C\frac{l}{\beta}$: l being the equivalent impedance and α and β the impedances of the branches. With the object of showing at a glance how the currents, impedance, angles of lag and watts in a single divided circuit vary when the period of alternation or resistance or self-induction of one of the branches varies, he gives three sets of curves. Those particularly interested in this subject are referred to the original paper.

Unit of Light.—From the report of Von Helmholtz, of the German Physical Institute, it appears that the photometric standard of light known as the Violle standard, in the form which Siemens has given it, shows variations of more than ten per cent. due to the premature ruptures of the platinum band. Greater thicknesses of platinum always give a value which is higher than that obtained from thin pieces. This standard has, therefore, been abandoned and replaced by a band of incandescent platinum at a fixed temperature measured by a thermo-electric couple of Le Chatelier. In this, a platinum iridium wire is soldered directly to the platinum band. This precludes the use of an electric current for heating the platinum, and as yet no other means of obtaining a constant temperature has been found. (It will be remembered that in the standard of Violle the temperature at the point of solidification is used, and it is, therefore, not apparent why this should not be adhered to.)

DYNAMOS AND MOTORS.

Coupling Alternators in Parallel.—In "L'Industrie Electrique," Mr. Boucherot describes the subject of alternators in parallel, and shows how the best conditions found in practice can be proved to be the best, by theory. His theoretical deductions, though doubtless correct, are not presented as clearly as might be desired, but the results obtained are of some interest and practical value. Practice has shown that the following conditions are those which are the most favorable for coupling alternators in parallel. The movable parts should have a sufficiently large moment of inertia, the dynamos should be run by independent engines, the internal resistance and the self-induction of the armatures should be as small as possible. Theory not only confirms this but indicates the values which should be given to the last two quantities to maintain synchronism, and also to keep the voltage constant. While it is desirable to make the self-induction as small as possible it is not possible to make it zero, and whatever value can be given it is, notwithstanding, larger than in an ideal machine; the self-induction, however, is necessary in order to facilitate automatic coupling. He proves that in dynamos which are most easily coupled when running empty, the internal resistance must be very small and equal to the inductance in apparent ohms, that is to 2π times the product of the frequency and the coefficient of self-induction.

It is generally thought that for coupling two alternators it is only necessary to have one much more powerful than the other. But this, he says, is an illusion. It is not the difference in the powers between the two machines which assures synchronism, but rather the power of that machine which is in advance of the other. It will suffice if the engine driving the dynamos has less power than that required to bring them out of synchronism, in which case if one alternator is loaded more than the other it will follow the other rather than get out of synchronism. He then gives a formula for determining what the maximum power of the engine should be. But making them of this power he says is not sufficient, because, if there is any difference of phases in the two machines it will affect the voltage. For a difference of phase between 0 degree and 90 degrees the difference of voltage will vary in the ratio of 1.4 and 1. To avoid this the synchronizing couple should be sufficiently powerful to avoid any difference of phases more than 20 degrees or 30 degrees. For a difference of 20 degrees he shows that the greatest power of the dynamo which is in advance should be a little larger than the greatest power of its engine, in which case the voltage will never be greater than one per cent. above the normal. He then deduces the value of the self-induction and finds the best condition to be that the inductance in apparent ohms should be approximately equal to the internal resistance. As an example he shows that in a machine giving a thousand volts and twenty amperes the inductance should have a value between 0.25 and 4 ohms, or a self-induction between 0.0005 and 0.01 henry, the best conditions being 0.002 henry. Machines without iron in the armature always have more than this, the inductance being about ten times the resistance, which shows that it ought to be reduced. It is not, however, the self-induction which should be considered, but really the inductance which depends on the frequency, and it is for this reason that the machines of Ganz, which have iron and a frequency of 40, are easily coupled, while those of Westinghouse, which always have iron, but a frequency of 130, are not easily coupled; although having the same self-induction they have three times the inductance.

To arrive at the best conditions of inductance and internal resistance the magnetic field should be as powerful as possible. Aside from the field there are two ways of accomplishing this, one by not having iron in the armature and the other by having iron and reducing the self-induction by the aid of condensers. It is difficult in practice with machines without iron to realize the condition of having the inductance equal to the internal resistance; in spite of this, however, owing to the latitude which can be given to the self-induction when small, the coupling can be accomplished quite well. The addition of a condenser has very beneficial results in diminishing the voltage lost in the armature. The moment of inertia should be made sufficiently large, but even this would not be sufficient to avoid uncoupling unless the other conditions, above given, are realized, as it will not act to bring the machines into synchronism if one is slightly in advance of the other. To avoid oscillation it is necessary to see to it that the steam engines themselves are running synchronously, that is, that the cranks have parallel positions. If, notwithstanding this, they oscillate, it is due to the fact that the synchronizing couple is too small.

An editorial comment on this paper calls attention to the fact that the coupling is rendered easier in the Thomson-Houston compound alternators, which have a separate excitation and in addition a series coil excited by the redressed alternating current of the machine itself. This compounding increases the power to synchronize by increasing the excitation, and, therefore, the power of the alternator which is in advance and reducing the excitation and the power of the alternator which follows.

ARC AND INCANDESCENT LIGHTS.

Mr. de Segundo in the Lond. "Elec. Rev." makes the following calculations for comparing the relative costs of lighting by gas and by electric lights. Taking the most favorable cases for electric incandescent lights, he says that it is extremely improbable that an electric lamp will ever be devised on the filament principle which will take less than two watts per candle, and that the cost of electric lighting supplied from central stations will ever, except in very few cases, be below 8 cents per kilowatt-hour. Under these conditions 3,200 candle power hours would consume a thousand cubic feet of gas, costing 75 cents (the average price of gas in England), while the 6,400 watts would cost 53 cents. But taking the existing conditions, he says, the average consumption of Edison-Swan lamps is three and one-quarter watts as an average throughout their life and two and one-half candles per foot of gas for the average burner. Assuming that the burner cost about 12 cents and the electric lights 90 cents, the price of gas, 75 cents per thousand, and electricity at 12 cents per kilowatt-hour, he finds that for a thousand hours the cost for gas will be $4.73 and for electricity $8.10, making the electricity 71% greater. For two and three-quarter watt lamps, costing 36 cents—figures which he thinks will be realized during the coming year—the cost of electric lighting will be brought down to $6.45, or 36½% greater than gas. In concluding he says: "The foregoing shows that in fairness and truth it is absurd for electricity to attempt to compete with gas, light for light, more especially when it is remembered that the illumination is effected in one case by a luminous filament and in the other by a sheet of burning gas."

The Welspach burner is a cause of great dissatisfaction in its home, Vienna, and it is claimed that its great advantages are entirely outweighed and even rendered illusionary by the fact that the glass chimneys used break very frequently, thus destroying the delicate incandescent cages.

ELECTRIC RAILWAYS.

Steep Grades.—The "Zeitschrift for Elektrotechnik" (Vienna) for January gives the following data of tests made with an electric car on steep grades. The accompanying table will explain itself. The line was constructed especially for the test, and was a portion of the well-known Budapest lines in which the conductors are in an underground slotted conduit similar to that on cable lines. The results show that grades of 1 in 10.4 can be mounted without difficulty, and that cars may be even started on such grades; that the difficulty, therefore, is not so much in ascending them as in the ability of braking on descending. The tests were made at night in order to eliminate disturbing conditions. In these tests the car was always started before the grade was reached. Each value in the table is a mean of a number of observations. The car was one of the regular cars of that line having a chain transmitter in the ratio of 11 to 31. In the second test only one axle was driven, while in the others both were driven. As the motors were not built for this purpose, their efficiency is naturally much lower than if they were constructed for steep grades. In conclusion, it is stated that there would be no trouble in mounting grades of 1 in 15.

Number of test	1	2	3	4
Weight of car itself in pounds	9,200	9,200	9,200	9,200
Weight of load "	5,600	5,600	825	825
Total weight "	14,800	14,800	10,025	10,025
Length of grade in feet	1,020	1,020	98	98
Grade	hor.	hor.	1:19	1:10.4
Time of trip in seconds	51	50	8	14
Speed in feet per second	20	20.4	12.3	7
Revolutions of armature per min.	549	560	337	192
Volts	282.5	285	266	260
Ampères	26.0	24.5	54.0	68.0
Electrical horse power consumed.	9.86	9.36	19.25	23.7
Pull in pounds per ton on a level.	30	30	30	30
Pull in pounds per ton on grade..	.....	.....	117	211
Total pull in pounds	221.	221.	682	682
Mechanical work in horse power.	8.12	8.30	15.3	14.3
Efficiency of the car machinery...	82.57	88.62	79.41	60.37

Mr. Reckenzaun, in the Lond. "Elec. Rev.," gives some details about the Vevey-Montreux Railway in Switzerland. When built in 1888 it was the longest line in Europe, being six and one-half miles in length. The overhead conductors consisted of a pair of slotted tubes forming a complete metallic circuit, and supported on wooden arms and steel wires stretched from pole to pole for taking out the sag. The power is furnished by a water fall. The voltage is 500, of which a mean of 367 appears on the line. The cars, for 30 passengers, weigh, empty, about 2.3 tons without motors; the motors and gearing weighing .82-ton, which is very light, comparing with our American roads. A unique feature of the road is a third attendant on each car called a "tubier" or trolley boy, who sits on the roof of the car and guides with his hands the contact slides. The cost of the road was about $130,000. The total running expenses are about $30,000, or about 12 cents per car a mile.

The "Elektrotechnische Zeitschrift" of Jan. 13 gives a very fully illustrated article on the power station of the electric railway at Little Rock, Ark.

CENTRAL STATIONS, INSTALLATIONS, ETC.

Stations in Great Britain.—The Lond. "Elect. Rev." of Jan. 13 gives a map of England showing the progress of electric lighting during the past year outside of the city of London. It also publishes a large chart giving various data about the 47 central stations in Great Britain, to which those interested are referred. Unfortunately much of the data which would be most interesting to Americans is wanting in all but a few isolated cases. The following general deductions from the chart may be of interest. The list of systems used embraces almost every variety of those which are acknowledged to be practical. It would be difficult to say which system predominates for incandescent lighting, but for arc lighting the Thomson-Houston and Brush systems are the rule. Steam is used almost entirely, there being but a few water power stations. The number of arc lights, from an American standpoint, is very small, and if the table can be relied on as giving the number of arc lights used for public lighting, it appears that public arc lights in Great Britain are very rare. Unfortunately there are so many blank spaces in the table that comparatively few general deductions of more than local interest, can be made. Most of the stations are very small, the largest being those in the London district, which have a capacity from 35,000 to 126,000 eight candle power incandescent lights; the latter is the Metropolitan Electric Supply, using low pressure continuous currents. It is interesting to notice that with but a few exceptions the wires for all these stations are underground, and from this Americans may well take a lesson; one of the London stations, the Ferranti, has as much as 70 miles of underground concentric cables. The prevailing price for a kilowatt-hour throughout Great Britain seems to be about fifteen cents; the lowest price is nine cents, which is in the city of Newcastle, where the price of gas is exceedingly low, being only about 44 cents per thousand feet. It may be of interest to note that in one of these Newcastle stations in which the price is so low Parsons steam turbines are used.

The Kensington & Knightsbridge station in London claims to produce a kilowatt-hour at a cost of 2.3 cents. The coal consumed has been reduced to 5.83 pounds per kilowatt-hour at the station and 8.58 pounds per kilowatt-hour registered at consumers' meters. In the Westminster Electric Supply Company's stations the coal consumption is 5.28 and 6.16 pounds, respectively, per kilowatt generated and sold.

The tariff in Berlin is 15 marks (about $3.54) per year for an arc lamp, and 2 marks (about 47 cents) for an incandescent lamp. The report is not explicit, but we presume this to be a fixed tax for the privilege of being connected. The tariff is furthermore based on the lamp-hour as a unit, it being 3.6 pfennigs (about 0.85 cent) per lamp-hour on a basis of .54 amperes per lamp of 16 candles.

Mr. Wright in discussing Dr. Fleming's recent paper states that transformers could not compete with low pressure systems within a radius of 1¼ miles from the station. The loss in a modern 20 h. p. transformer with 99 per cent. efficiency he states to be the same as the cost of three-wire mains of 1¼ miles in length.

In specifications for lighting the City of Santiago in Chili the municipal authorities inserted the following clause: The tenderer binds himself to pay a penalty for every hour during which a lamp does not burn. The penalty for an incandescent lamp per hour is about 5 cents, and per arc lamp about 50 cents.

The "Elektrotechniache Zeitschrift" of Jan. 13 gives a very fully illustrated description of the Heilbronn three-phase alternating current plant, most of the illustrations of which have appeared in the columns of The Electrical World (see issue of Jan. 21, p. 45).

Gas Power for Electric Lighting.—In a paper read before the Institution of Civil Engineers, London, Mr. Dowson stated that an aggregate of 7,000 h. p. of gas engines were used in Great Britain for electric lighting, and up to an aggregate capacity of 1,100 arc and 90,000 incandescent lamps in Germany. He stated that the varying load factor in central stations was a serious trouble, and he hoped to be able to show that much of the present loss due to fuel, water and wages would be avoided by the use of gas engines. Referring to the central station at Dessau, Germany, where a 120 h. p. gas engine was used, the consumption of gas was 39 cubic feet per kilowatt-hour. In spite of the loss of about 21 per cent. in the accumulators used in this station large engines worked more profitably in parallel with them than smaller ones supplying direct without an accumulator. In the suburb of Munich a small plant, producing its own gas, showed a consumption of 3.3 pounds of coal per kilowatt-hour. In another similar small plant, having an output of 1,155 kilowatt-hours per week, the consumption of fuel was 2.58 pounds and the cost of the gas, including wages and fuel, was one cent per kilowatt-hour delivered. In a small private installation in France for 650 incandescent lamps and one arc, the consumption was 1.2 pounds per indicated horse power and 2.7 pounds per kilowatt-hour. It has long been known that with a dynamo run by a gas engine more light could be produced than by burning the gas directly in the burners. With the modern improvements in gas engines he says that the ratio now is 20 to 1 in favor of gas converted into arc lights by means of a gas engine. From compilations made from various sources using town gas, he says the average is 47 cubic feet per kilowatt-hour. When accumulators were used the consumption was less because the engines then worked under full load all the time. At 47 cubic feet and 55 watts per 16 c. p. one lamp required only 2.6 cubic feet per hour, whereas the standard argand burner required 5 cubic feet. The question of load factor was a serious one in any type of engine, but with gas engines the loss was much less than with steam engines. When a gas engine stops its consumption of fuel stops also, and there is no furnace to maintain, nor water to boil at starting. It is, however, desirable that gas engines should be worked as much as possible under full load. In general, he says that it may be assumed that the consumption of coal was more than six pounds per kilowatt when accumulators are used and from nine to twelve pounds when accumulators are not used. In steam engines there is at best always a large consumption of fuel in banked fires and in starting which does no useful work. With gas engines one brake horse power could be obtained with 1 pound of anthracite or 1⅓ pounds of coke, while with steam engines, used in central stations, it must be taken at about 2½ pounds, showing a saving of about 50 per cent. in favor of gas when fully loaded. For a maximum of 400 kilowatts three gas generators would be required; they have much less cooling surface than a boiler, contain no water and require no chimney draft. One of these generators loses only 6 to 8 pounds per hour while standing idle. He stated that what is known as the Otto cycle would, in his opinion, have to be altered, especially when generator gas was used. In conclusion he says that in electrical stations supplied with city gas the consumption was about 50 per cent. less than that required for the same amount of light from burners. Neither boiler nor firemen were required, no ashes are to be removed, less space was needed, no accumulators were required except to equalize the load and provide an amount for storage. They could be worked in crowded districts close to where the lights were required and where boilers were not allowed. Where generator gas was used the consumption of fuel under full load would be at least 50 per cent. less than with steam power. The author appears to be the inventor of the Dowson gas, to which he refers frequently in his paper. We call attention to the fact, not stated directly in this paper, that the efficiency of a gas engine depends to a great extent on how fully it is loaded; at light loads its economy is very materially reduced and its speed is not constant.

Gas Engines. M Witz has been calling the attention of French engineers, by a paper read before the Societe Industrielle du Nord, to the latest and very remarkable progress achieved in this class of engine. In tests which he carrierd out at Rouen two years ago, a 100-h. p. gas engine was found to consume 600 grammes (1.32 pounds) of anthracite per effective horse-power hour. Nowadays this result is being obtained in commercial practice. The motors are not fed by the town gas, but a gasogene is added, which requires little attention, and the production of gas is regular and constant. This gasogene takes the place of the boiler. A poor quality of gas is utilized, giving about 1,500 calories per metre cube at 0 degree C. and 760 millimetres pressure. The process is not new, having been described by Thomas and Laurens in France, and Siemens in Germany, while heating gas is produced by Dowson, Lancauchez, and others, at a price very much less than was before possible. The efficiency of the gasogene is as high as 80 per cent., while the best boilers do not exceed 70 per cent. Moreover, M. Witz points out, the gas engines give a gain of 28 per cent. in efficiency over the best constructed steam engine. These results show a total gain in efficiency, justifying the most brilliant hopes for the future of gas engines. The tests show that in everyday practice a brake horse-power hour can be obtained for less than 600 grammes (1.32 pounds) of anthracite; Crossley has obtained the same result with 783 grammes (1.72 pounds) of coke. The speed is sufficiently regular to drive dynamos satisfactorily.—(London Electrical Engineer.)

TELEGRAPHY, TELEPHONY, SIGNALS, ETC.

Microphone.—One of the few really novel forms of microphones and one of the most interesting is described in "L'Electricien." If it does all that is claimed for it, which we have no reason to doubt, and if, as is claimed, it does not infringe on the Berliner patent, it may have a most important bearing on the telephone industry in the United States.

All microphones heretofore invented consisted of loose carbon contacts. Such microphones are all limited to certain ranges. If the pressure at the points of contact is light the microphone will be very sensitive and will transmit very feeble sounds, but in that case louder sounds will produce rupture at the contact, in which case there are produced the disagreeable grating sounds so often heard in telephones. If on the other hand the pressure at the contacts is made great, the microphone is less sensitive and it becomes necessary to speak very loud. In practice a mean pressure is therefore used.

In the present invention, which is that of Mr. Clamond, all these objections are overcome completely. He has departed entirely from the loose contact typical of all other microphones and replaces it by a plastic body of poorly conducting material. For this purpose he makes a plastic paste of an intimate mixture of an exceedingly

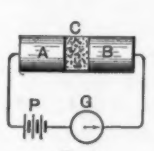


Fig.1.

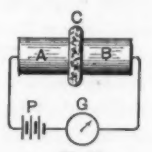


Fig.2.

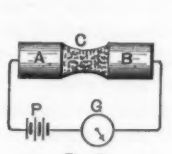


Fig.3.

fine conducting powder, with a viscous liquid having a more or less poor conductivity. The action of this plastic mass will be seen in the exaggerated diagrammatic representations in Figs. 1, 2 and 3, A and B representing two carbons joined by the plastic mass C. P is a battery and G a galvanometer. Fig. 1 shows the normal condition; Fig. 2 shows the plastic mass compressed, in which case its length is shortened and its cross section increased, both of which diminish its resistance; the galvanometer shows an increase of current. Fig. 3 shows the plastic mass elongated and consequently its section diminished; the galvanometer shows a diminished current. If carbon A is fixed and B attached to a microphone diaphragm, the plastic mass will evidently act similarly to the loose contacts in the ordinary microphone. It is, of course, necessary to determine the best relative proportions in order to produce the best effects. It is said by Mr. Clemenceau, one of the editors of that journal, that the results obtained are quite surprising. The telephone transmits with the same intensity the loudest as well as the softest sounds. The same microphone without any regulation whatsoever will answer for the most widely different transmissions and the audition is always clear, sharp and loud. Whether this plastic mass will retain its shape and consistency for long periods remains to be seen. The principle certainly seems to be a very good one.

A Curious Telephonic Phenomenon.—In quoting from the "Zeitschrift fur Elektrotechnik," an article in "L'Industrie Electrique" describes an interesting phenomenon observed by Mr. Dockert, of Vienna. A carbon or graphite microphone of great sensitiveness, connected in short circuit with its battery and the primary coil of its induction coil, has its diaphragm placed at a very short distance from a well constructed telephone, preferably one of bipolar construction such as that of Siemens. If one blows or whistles into the space between the two diaphragms the telephone will produce a high musical note of a fixed pitch. The sound is very intense and under certain conditions will continue indefinitely and can be transmitted to great distances. The sound is like that of an organ pipe, and its pitch can be varied by an octave. The telephone will not always give this sound by itself, but under certain conditions it may be started by a mere light touch and sometimes it will even start spontaneously. The pitch of the note may be varied by varying the distance between the telephone and the microphone, as also by changing the inclination between the two. The sound ceases when the diaphragms are perpendicular to each other, and is greatest when they are parallel. A large short tube between the diaphragms increases the sound, as does also an increase in the battery power. One of the conditions is that the telephones be constructed with the greatest precision and that they be properly connected with regard to their polarity; by reversing their polarity the sound ceases. By connecting a second telephone in series with the first the sound may be transmitted almost two hundred miles. (Although not stated in the description we assume that the first telephone must be connected in series with the secondary coil of the microphone induction coil, in which case the telephone forms the receiver for that microphone.)

Numerous uses are suggested for this phenomenon in practice, one of which is to transmit signals to great distances, thus dispensing with bells, batteries and other calls. Another is to construct a purely electrical organ for musical purposes, and it is stated that the firm of Deckert & Holmolka are constructing an organ of this kind for the World's Fair.

Several explanations are offered, one of which is that the passage of the currents across the microphone contacts produces elevations of temperature and consequent expansion and subsequent contraction, which produce variations of currents; this produces vibrations in the telephone membrane, which, in turn, are communicated by purely acoustical means back to the microphone diaphragm, thus increasing the action at the microphone contact; the original action is, therefore, increased by its own effect on the telephone. This explains why the action may be spontaneous, and also why it continues when once started.

The London Post Office Telephone.—The London Post Office concludes that the Gower-Bell transmitter and the Bell receiver furnish the elements for an instrument combining the maximum efficiency and simplicity, suitable alike for short telephone lines as well as for the longest lines at present used. A full illustrated description will be found in the London "Electrician" of Jan. 13.

Submarine Telegraphy.—The London "Electrician" continues its series of articles on submarine cable work.

ELECTRO CHEMISTRY.

Estimation of Lead by Electrolysis.—Mr. Medinus in the "Berichte" describes the following process: In alkaline solutions free from chlorides lead may be estimated by precipitation as an oxalate, which is dissolved in nitric acid after being washed, and is then converted into lead peroxide by electrolysis. If lead chlorides are present in the original solutions they are dissolved in potash, after which carbonic acid gas is passed through the solution for two hours and the precipitate treated with nitric acid and electrolized as described. The method is said to be quite trustworthy.

Electrolytic Separation of Metals.—Mr. Le Blanc describes in the "Zeit. Physikal. Chemie," a new and very interesting method. The paper is very long, but his conclusions are as follows: Metals may be separated from each other by employing currents of different electromotive force. A current of 1.35 volts will cause the separation of silver from copper and bismuth; also mercury from copper, bismuth and arsenic. Experiments proved the correctness of his theoretical deduction and show very close agreement with chemical analysis.

Aluminum.—The Aluminum company at Neuhausen (Switzerland) state that at the beginning of last year their sales were at the rate of 56,000 francs per month, and at the end of the year 130,000 francs. A net profit of 166,577 francs was made during the year. The price was reduced from 1,900 francs per 100 kilos to 625 francs (about 56 cents per pound. The horse power is 2,100. They produce 20 tons of pure metal per month. The greatest demand for this metal is stated to be for alloying with iron and steel.

MISCELLANEOUS.

Electric Anesthesia.—Dr. Wm. F. Hutchinson, of Providence, has succeeded in obtaining local anesthesia by electrical means. At first he used vibrating hammers to obtain the effect by percussion. After much experimentation, he constructed an induction apparatus, consisting of carefully calculated coils and having a rheotome of phosphor-bronze ribbon that could be easily regulated. When set to give C major, representing 540 vibrations per second, marked anesthesia was produced. though if more rapid the effect was lost. At A major, one minute produced numbness. An attempt was made to produce local absence of sensibility on a patient suffering from a felon on the forefinger. The finger was placed in a metal tube filled with sponge moistened with salt water. Starting with A and running up to G sharp, in three minutes sensibility was not diminished; but tuned to C major, sufficient anesthesia was produced in three minutes to allow of incising the felon without pain. In a case of tic-doloureux, the rheotome being adjusted to C, the negative electrode was applied to the nape of the neck and the positive to the forearm, and in ten minutes the pain had completely disappeared, the patient enjoying a sleep afterward for the first time in two days. With the apparatus described Dr. Hutchinson was able to produce local anesthesia with ease over an area

about one inch greater than that of the electrode. The experiment may prove to be of great value in surgical operations.—London Electrical Engineer.

Electroculture.—A paper is given in the "Bulletin" of the Societe Belge d'Electriciens by M. E. Lagrange on the subject of the influence of electricity on the growth of vegetables. M. Lagrange divided a plot of land into three parts, and planted the whole with potatoes. In the first plot he buried a plate of copper and a plate of zinc, a foot square, 26 feet apart, joining them by a wire carried on insulators strung on cross wires. The second was cultivated by the ordinary method. The third had a number of small pointed conductors buried to six inches below the surface, and rising 18 inches above it, connected to an underground network of galvanized wires. All plots were submitted to the same care, and were under the same conditions of soil, sun and rain. The result was that the first plot gave 60 kilogrammes of potatoes, the second 80 kilogrammes, and the third 103 kilogrammes. This showed that the current electricity had, if any, a bad effect on the crop, while the static electricity gave considerable increase. But M. Lagrange found that in the first plot, though the yield was less, the leaves appeared sooner, the plants were larger and more thickly leaved, from which he argued that for plant cultivation current electricity proved effective, but for root crops static electricity was to be preferred.—London Electrical Engineer.

An Electric Saw.—Commenting on the fact that the American press has lately called attention to the sawing of wood by means of a wire heated by an electric current, Mr. Turner, in "L'Industrie Electrique," publishes an extract, including illustrations, from a French patent for this invention, dated 1868, granted to a Mr. Pignoni. The illustration merely shows a few devices for holding stretched wires for various purposes, among them for a hand-saw, a saw for scroll work and multiple saws for sawing logs into boards.

NEW BOOKS.

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY. 786 pages. New York: The W. J. Johnston Co., Ltd., publishers. 1892 Price, $5.00.

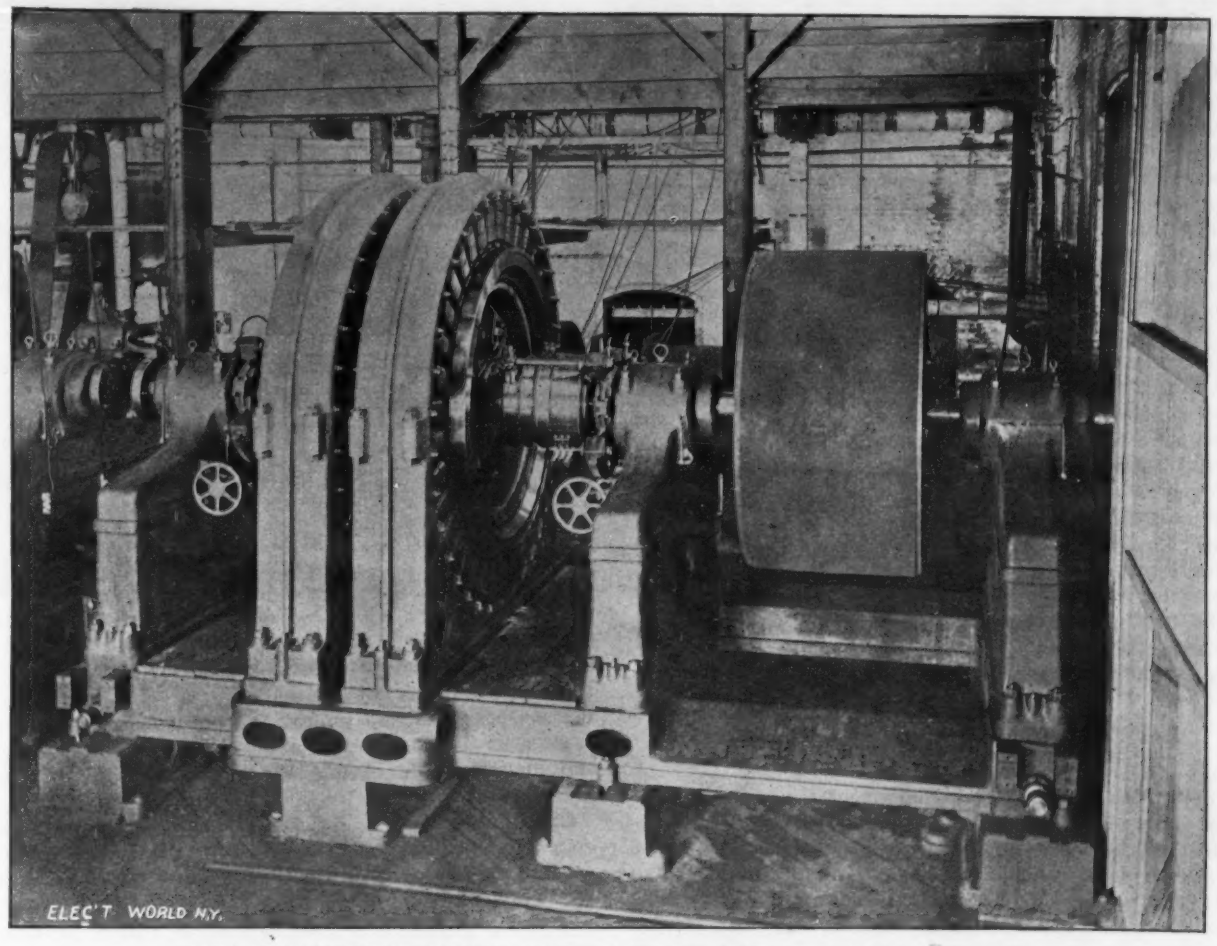
This Directory, just issued from the press—which is the only American Directory published covering the general electrical and street railway industries—aims to furnish the most complete and reliable information obtainable relating to the electrical interests of the United States and Canada, and to so arrange and classify this information as to render it most useful for reference to both buyers and sellers. This is the fourth year of publication of the Directory, though the first under the auspices of The Electrical World. The book has been very considerably enlarged, and many changes have been introduced in this issue which it is hoped will materially add to the value of the Directory. The thoroughness of the effort to have the information full, accurate, and complete may be judged from the fact that, in addition to a careful personal canvass in the larger American cities by representatives of The Electrical World, 54,000 letters, inclosing 54,000 addressed postal cards, were sent to electric light central stations, isolated plants, electric mining plants, street railways—electric, horse and cable—electrical companies, telegraph companies, telephone companies, manufacturers and dealers in electrical street railway specialties and supplies, and others, throughout the United States, Canada, Mexico, and Cuba. A notable feature of this edition of Johnston's Electrical and Street Railway Directory is the facilities offered for rapid reference to the various business interests, making it a valuable reference book for buyers. The different manufacturers of and dealers in electrical and street railway apparatus, machinery and supplies, electricians and others, as well as houses connected with kindred interests, are arranged alphabetically in a general list by States, cities and towns, also under their appropriate business headings in a classified list, and finally in an alphabetical "finding" list. Another feature consists of giving the names of the managing officials, purchasing agents, superintendents and electricians of electric light central stations and of street railway companies, and the owners, purchasing agents, electricians and engineers of isloated lighting and electric mining plants. There are also several other features of this edition which will commend themselves to the users of the Directory. The desire to make the book as complete as possible caused a delay in its publication, but hereafter the Directory will be issued earlier in the season, and the effort will still be to further improve it.

Damage by Snow to the World's Fair Buildings.

A dispatch from Chicago on Saturday last states that considerable damage has been done to the roofs of Machinery Hall and the Liberal Arts building. It seems that the weight of the accumulated snow was increased to such an extent by a subsequent rain that the supports were no longer able to withstand it, and in both cases portions of the roofs mentioned gave way. Many of the other roofs have sprung a leak, but since but little perishable matter has as yet been placed in position the damage has not thus far proved great.

The New Westinghouse Alternators and the Separable Lamp.

The exhibition of the World's Fair machinery, which the Westinghouse Electric and Manufacturing Company held during the last week at their machine shop in Allegheny City, was one of the most interesting displays of electrical apparatus that has taken place for some time. The exhibit consisted of the 10,000-light Westinghouse alternating current dynamos contracted for by the Columbian Exposition Company for illuminating the World's Fair buildings, and also of the new Westinghouse incandescent lamp. The machines were in actual operation and the lamps were burning during the whole time of the exhibition. The affair had been arranged by the Westinghouse company to give Pittsburghers an opportunity of seeing the first of these machines before it was shipped to the World's Fair grounds, and to give them the chance of viewing the new lamps as soon as they were on the market. That the exhibit created a great deal of interest is best attested by the many people who came to view it. During the five days of the exhibit over 3,000 visitors were admitted through the gates, admittance having been secured by card.



THE NEW WESTINGHOUSE ALTERNATORS FOR THE WORLD'S FAIR.

One of the huge dynamos had been placed at the entrance of the machine shop. It was belted by a 34-inch belt to a line of shafting from Westinghouse engines. In order to form an approximate idea as to what one of these machines is like the following description and figures may be interesting:

In general the dynamos are designed similar to all Westinghouse alternating apparatus. Each dynamo is really a double machine, there being two separate magnetic fields and a split armature. The dynamos have tooth armatures, each of which is 90 inches in diameter and weighs about 75 tons. They will generate a 2,000-volt current, and the maximum capacity of each machine is 15,000 16-c. p. incandescent lamps, while their rated capacity is only 10,000 lights. The World's Fair contract calls for 12 of these dynamos. Six of them will be belt-driven, while six will be direct connected with 1,00-h. p. Westinghouse engines.

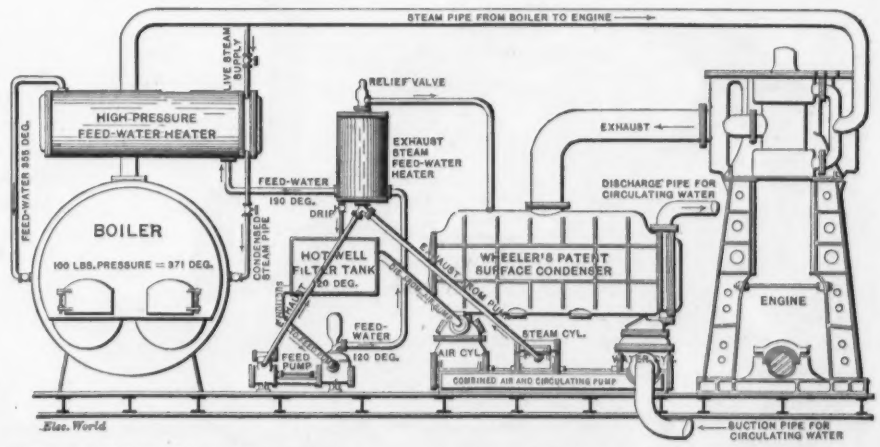
The exhibition of the new Westinghouse incandescent lamp proved equally interesting to the visitors. Of all the new things which have been brought out in the electrical industry lately, the new Westinghouse lamp has caused the most talk, and every one has been anxious to see it. The lamp, as has been repeatedly stated by the Westinghouse people, differs widely in many respects from any incandescent lamp now on the market. Its separable parts, the glass stopper, the new socket, the novelty of its construction and last the brilliancy of the light caused general and favorable comment; and the fact that its cheapness is destined to work a revolution in the entire electric lighting business, making it more general and popular, was made a subject of congratulation to the company by the visitors.

It may be incidentally remarked that the visitors were chiefly prominent manufacturers, business and financial men of Pittsburgh and Allegheny, as well as engineers. On Friday afternoon the engineering class of the Western Pennsylvania University attended the exhibition in a body.

The Peck-Wheeler System of High Temperature Feed Water Heating.

The higher feed water is in temperature the greater the economy in fuel and the longer the life of the boiler; to say nothing of the considerable increase of its steaming capacity. Heating feed water by steam taken direct from the boiler, although tried many years ago in this country, was never followed out to any successful issue until recently in England, where, however, the practice was limited to a comparatively incomplete arrangement.

The Peck-Wheeler system (patented) is the result of exhaustive experimenting, and its object is to obtain all the heat possible out of the exhaust steam from the main engine by operating the air pump so as to get the temperature of the feed water in the hot well as high as is consistent with a good working vacuum—say a temperature of 120 degrees F.—and then to further heat the feed water by passing it through a small exhaust steam heater, into which the feed water pump, air pump and circulating pump, and any other steam pump or auxiliary engine, may exhaust; such exhaust steam being entirely condensed by the feed water, while at the same time the latter is raised to a temperature of from 180 to 190 degrees F., as it passes on its way to the live steam heater. The feed water, after being heated to maximum temperature in this special live steam heater enters the boiler at very nearly the temperature of the steam within the boiler. The steam which is condensed in producing this result flows to the boiler by gravitation. The accompanying cut shows clearly the operation of this arrangement. The steam pressure in the boiler is, say, 160 pounds gauge pressure, representing about 371 degrees F. On the main steam pipe near the boiler is shown a branch pipe for supplying live steam to the high pressure feed water heater. After the steam is used in the engine (triple expansion) it passes through the exhaust pipe to the Wheeler surface condenser as shown.



THE PECK-WHEELER SYSTEM OF HIGH TEMPERATURE FEED WATER HEATER.

The water of condensation is taken by the air pump (which is immediately under the condenser) and discharged into the hot well filter tank, where the temperature averages 120 degrees F. This feed water, after passing through the filtering material in the tank, flows to the feed pump which forces the water to the boiler, first through the small exhaust steam feed water heater, where, as before stated, it is raised in temperature to about 180 degrees or 190 degrees F. The cut shows the exhaust steam from the combined air and circulating pump and feed pump exhausting into the heater, where it is entirely condensed by the feed water passing through its coils or tubes, the water of condensation gravitating to the hot well filter tank below and mingling with the feed water therein.

As clearly shown, the feed water after passing through the small supplemental exhaust heater enters the bottom of the live steam heater at one end and flows out at the top at the other end, where it emerges at a temperature of about 355 degrees F., and then passes down to the boiler. The live steam is taken from the main steam pipe, as shown, or from the boiler direct, as preferred. This steam passes through the inside of the tubes of the heater, and after being condensed gravitates to the boiler through the vertical pipe shown on the other side of the boiler.

It will be seen at a glance how simple the whole arrangement is, and how the feed water is heated from an initial temperature of 120 degrees F. to a terminal temperature of about 355 degrees F., or, in other words, an increase of about 235 degrees F. is obtained for the feed water in its progress from the hot well to the boiler.

The advantages claimed by the Wheeler Condenser and Engineering Company for the Peck-Wheeler system are: Economy in the use of fuel, varying from six to ten per cent.; increase of steaming capacity of the boiler, varying from fifteen to twenty per cent.; longer life to the boiler; purifying the feed water in the heater; less fluctuation of steam pressure in the boiler; less weight, space and first cost for boiler and less expense for repairs.

Hub Friction Clutch Pulley Cut-Off Coupling.

The Hub friction clutch consists of a wood-filled hub on one part and an encircling ring, in halves, lying within a recessed hub on the other part. The clutch is effected by drawing the ends of the half rings together by levers at each end operated by wedge end levers, which in turn are worked by toggle levers, connected to a sliding spool on the shaft. When the spool is moved toward the hub, the great power of the multiplied levers draws the half rings together with strong pressure on the hub. The toggle levers pass beyond the centre locking themselves so as to require pressure to release, and there is no chance of coming out of clutch. The release of the rings is by the action of springs.

During the action of clutching in to power, one side being at speed, there is an instant when the half rings and hub are in slipping contact, and the inertia of the shaft to be set in motion is gradually overcome, and the force applied to the shifter lever being steadily increased the half rings grasp firmly on the hub, and the toggle levers pass into lock with the two parts of clutch firmly and rigidly coupled in, until released by a reverse motion of shifter lever.

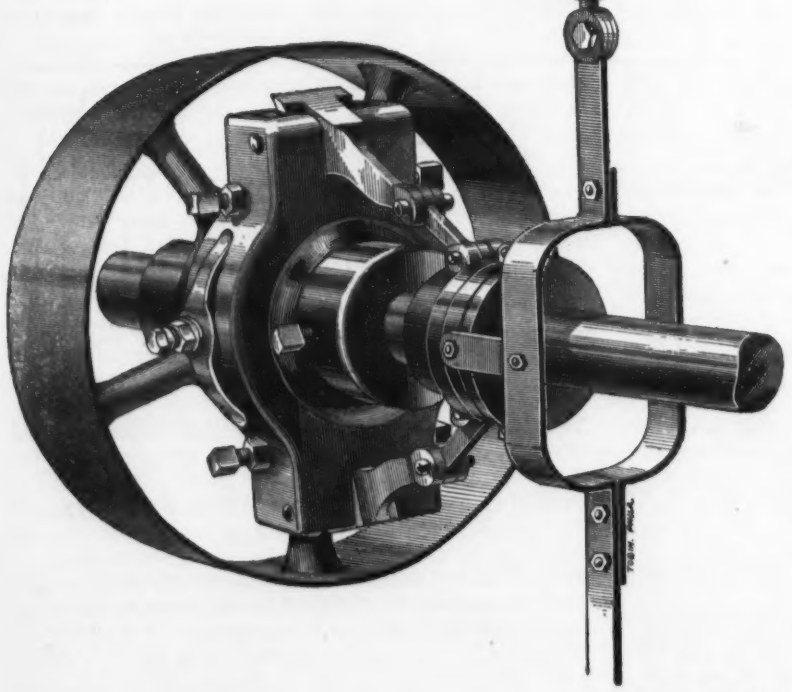
The oil cups freely lubricate the friction surfaces, preventing cutting or heating while clutching, or while running out of clutch. Ease and steadiness of movement are assured by the great power of the multiplied levers and mechanical powers employed in the clutch proper, which is again increased by the shifter leverage. Geared movement is not necessary with these clutches, but can be applied if desired.

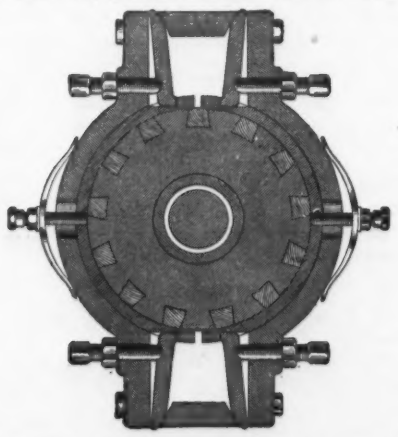
The clutches are entirely free from danger of fire in all classes of manufacturing, from heating or throwing off sparks, because the friction surfaces are freely lubricated, and in addition the wooden insets become thoroughly saturated with oil, and are self-lubricating in case of neglect in oiling.

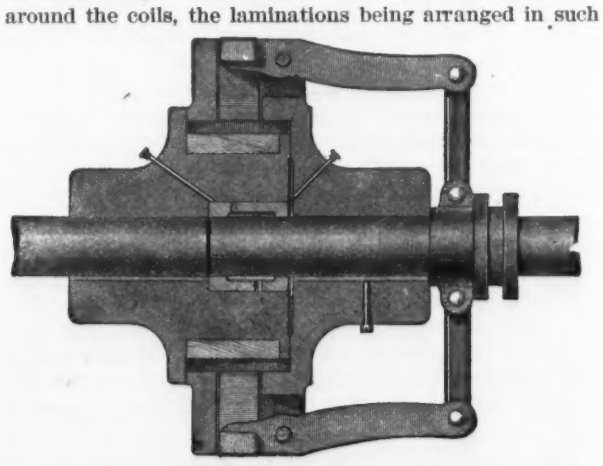
The Hub friction clutch takes hold of a pulley at the strongest part and at a point where the speed of the friction surfaces is not as great as at a point on or near the periphery of the pulley, in consequence the heat created at slipping contact is not nearly so great, while the encircling grip of the hub is of ample strength to take up and carry the load.

Great durability results from the simplicity of the clutch, and the provision for full lubrication. The original clutch was made with a single lever movement for closing the cut ring; but for use at very high speeds and larger powers a double movement clutch is now made, possessing all the good features of the former while giving greater clearance and quicker movement. The half rings and double movement also provide a wider range of self-adjustment to inequalities of surface which may result from long continued wear. The double movement is a most important feature.

These clutches are especially adapted to electric light and power plants, and for isolated electric lighting in mills, factories, etc., where by the use of the Hub friction clutch pulley on the line shafting a dynamo can be thrown into operation without stopping or slowing down, furnishing lights at any time the mill is running. The clutches are now made in all sizes up to 1,000 h. p., with a capacity of increasing to larger sizes and for any speed up to 1,000 revolutions per minute.





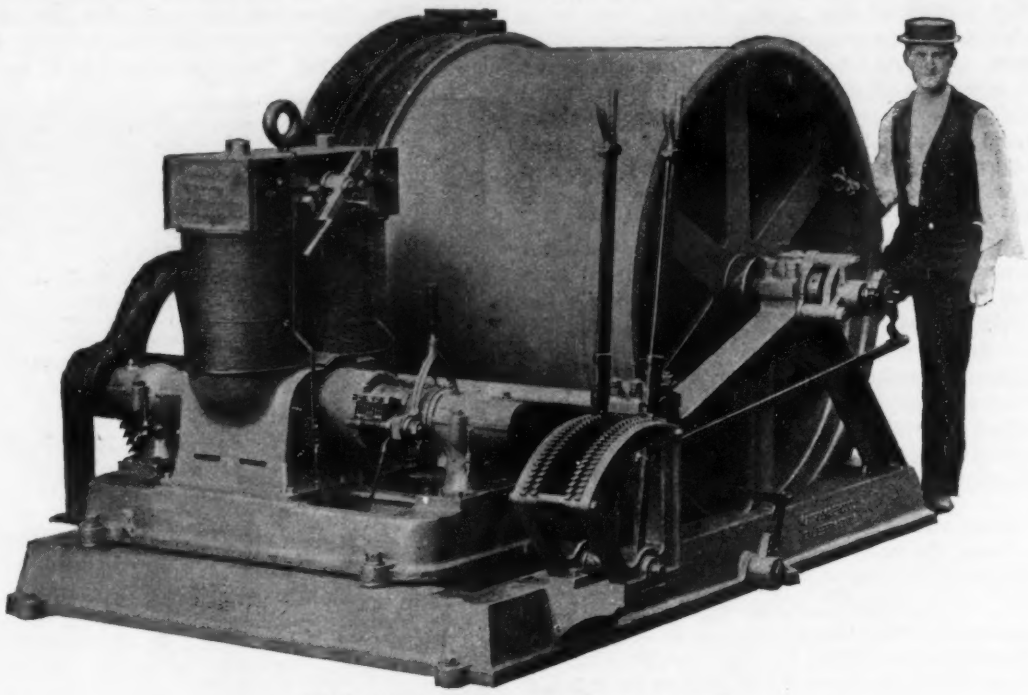


HUB FRICTION CLUTCH PULLEY CUT-OFF COUPLINGS.

New Mining Hoist.

A new electrical mining hoist has been recently brought out by the General Electric Company, which is an advance in the manufacture of this class of apparatus. It is constructed with the especial object of obtaining a wide range of hoisting speed, to which end the controlling apparatus has been carefully perfected. The drum is of unusually large diameter, and is connected by an intermediate gear to the armature shaft of a 25 kilowatt (30 h. p.) motor of the General Electric Company's regular bi-polar type. The controller for the motor, which is not shown in the cut, is similar to that used in street railway service, and is erected on a separate support conveniently within reach of the operator and directly to the right of the levers. These can then be operated with the left hand, and the controlling switch with the right. The series method of electrical control is adopted, the speed being increased or decreased to meet requirements by the movement of the switch handle. The hand brake is of thet band type, lined with wood, and extends almost entirely round the drum. The drum is thrown into operation by a clutch operated by the second lever.

The range of speed obtained on this hoist is very wide.



THE NEW EDISON MINING HOIST.

It is designed to raise loads of 1,300 pounds at a rate of 600 feet a minute, and has successfully accomplished this. It can also raise loads of 100 pounds at a speed not exceeding 20 to 30 feet a minute.

The motor is erected on its own bedplate, bolted to the bedplate of the hoist proper, the whole apparatus occupying comparatively little space owing to its compact construction.

This hoist, by its specially advantageous features, should command the attention of mine managers and superintendents anxious to procure the most efficient apparatus.

Asbestos Porcelain.

Asbestos fibers are ground to a fine powder, mixed with water, kneaded, mixed with water again, dried, and again kneaded and poured in molds. Heated to 1,700 degrees C., it gives a mass like porcelain. Heated to 1,200 degrees C. for eighteen hours, it gives a porous mass. Porous cups thus made are said by Prof. d'Arsonval to have a very much lower resistance in batteries. He states that its insulating resistance is 2.75 times that of the ordinary porcelain.

The Elkhart Converter.

In construction the Elkhart converter is at once attractive, convenient and compact. The case, as is customary, is an iron waterproof shell, constructed with a view to the least possible weight consistent with the necessary strength.

Its special feature, however, is its electrical construction. The coils are wound in an oblong coil extending the full length of the case, the secondary being first wound on a form and the primary wound over and upon the secondary. The iron is then built up inside and around the coils, the laminations being arranged in such a way that the joints are broken in every layer, that is, the joints do not come in the same place in any adjacent laminations. The result thus attained is that the coils are surrounded entirely by iron, making the converter almost a solid mass of iron, but at the same time broken up in a way that effectively prevents the action known as hysteresis, which causes heating and magnetic loss.

The Elkhart converters are being exploited in the west by the Electric Appliance Company, of Chicago.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Jan. 28, 1893.

The general financial market of the week was of a very complicated nature. It can be said with truth that even prominent operators who usually control conditions were more or less at sea up to the closing of to-day. Along certain lines it has been a decidedly bullish week and along others decidedly bearish. Two lines of stock have furnished more than half the transactions, and can be said to have dominated with their influence the entire market. Reference is made to American Sugar Company and Distilling and Cattle Feeding Company. Early in the week Mr. S. V. White started his bull campaign in the former security, and so skillfully was it manipulated that before the bears were aware they had accumulated a very heavy line of short stock, which they had no prospect of covering at any point near which it was purchased. It was on Thursday night that they arrived at a realization of their perilous position. On that date the stock closed at 125. The net advance for that day was about four points. On Friday a squeezing process was the order, which was continued up to the close to-day, resulting in forcing the bears to cover and the quotations to 132½. At this latter figure the stock looked a little top heavy, but no large interest had the timidity to sell it short. It reacted, however, to 128¾ at the close. Its course next week is, of course, largely a matter of speculation. Mr. White prophesies 150, just as he prophesied 130 when the stock was selling at 110. Just at present he is the king bee in the New York Stock Exchange, and it is believed that his deal is not yet over. The stock of the Distilling and Cattle Feeding Company took a direction diametrically opposite to that of Sugar, selling down from 59⅝ on Monday to 46 yesterday and to-day. The story of the deal was partially told last week. Its history during the period under review is a repetition. The large houses who were bulling the stock when it was in the sixties claimed that certain of their co-operators were guilty of treachery, and threw over their holdings. The transactions during this week were enormous. A great many of them were short sales and the purchases, it is believed, were largely made by the investing public. Various insiders who were caught with a lot of long stock around the sixties and who let the same go with a loss are now said to be anxious to pick it up at present or lower prices. To this desire is attributed the cause of the various bear rumors which were circulated during the week to the effect that the company's securities were being hypothecated; that its goods were adulterated; that there was a probability of Congressional interference, etc. We understand that the directors of the company have taken the matter in hand and are now holding sessions in this city for the purpose of making an official statement showing the exact financial condition of the company. It is understood that they will reduce the price of spirits five cents per gallon, in order to meet the slackening demands of the trade. The market next week is apt to be just the reverse of that of this week. We look for a decline in Sugar and an advance in Distillers. The bank statement this week showed an increase of $613,700 in the surplus reserve, and when it is considered that the $4,300,000 gold exported last week figures in this statement, the showing is not at all unfavorable. The exports this week were $3,300,000 and the engagements thus far for next week's shipments are $1,500,000.

NEW YORK ELECTRICAL STOCK MARKET.

The attention which this list of specialties received this week was more or less indifferent, owing to the fact that the operations of the professional traders were in other quarters. This left the market largely to investment buyers, and caused a slight sagging in two of the active stocks, namely, Western Union and General Electric. As proof that the public is interesting itself it can be said that monthly the inquiry for the better class of the inactive stocks and bonds is becoming more pronounced. These points are treated elsewhere. North American was dealt in in an indifferent way, between 11¼ and 11⅜. American District Telegraph at 56 and 57½ was very quiet. A dividend of 1¼ per cent. was declared payable Feb. 20, 1893. American Telegraph and Cable advanced to 91 on limited sales. This latter company held its annual meeting this week. No business of importance was transacted. Indications point to a substantial market of the investment order next week. We expect to see prices maintained, and would not be surprised if they should score an advance.

Inactive Electrical Stocks.—An expert in this class of securities says that there are only moderate transactions in stocks like the Brush Electric, Edison Ore Milling Company and the Phonograph securities. These inquiries and orders come almost exclusively from the electrical men. It is very seldom that an investor in any other line of business purchases any of these stocks. From this he argues that those most intimately acquainted with the values and the securities are doing the buying, from which he deduces the conclusion that the general public, slow to appreciate a good thing, but ravenous for it after its qualities are thoroughly understood, will some day be actively in the market. As an illustration, he cites the history of the Edison Electric Illuminating of New York; when it was about 80 capitalists had to be fairly begged to buy it. They are now anxious to secure a small line at 125.

Electrical Bonds.—A feature of the market this week was the transactions in the electrical bonds, which show an increase in sales and an advance over last week's prices. The buying was for investment in small lots, and aggregated several hundred thousand dollars. One of the surest indications that any security is growing in public favor is an inquiry for the bond lien upon that security. A lot of Western Union debenture fives sold at 106, a net gain of one point over the last recorded transactions. Of the General Electric fives, $40,000 sold in small lots over the same range of prices which ruled last week, viz., 100½ to 101. The strength of these bonds in the face of the weakening tendency of the stock shows that the latter condition may be attributed to manipulations or realization sales, and not to any adverse conditions or facts relative to the property. The Edison Electric Illuminating's first fives were in excellent demand, some $90,000 worth selling from 118¾ to 120½, closing strong at the latter figure. Three thousand dollars of the Mutual Union Telegraph Company sixes sold at 112½ to 113. Northwestern Telegraph sevens were bid 108.

Western Union.—This stock dropped on Monday below par. A good authority says the break was for the purpose of catching stop orders known to have been placed around 99⅛. This stock was caught by bulls, and the price immediately thereafter improved. A Vanderbilt interest has been doing considerable in Western Union of late. The talk that Mr. White made the last move is not true. He has had comparatively little to do with it. A portion of what may be called the Vanderbilt stock has been sold, but the trading suggests that it may be taken back. Western Union above par becomes an investment for various institutions, and I think there has been buying for these accounts. The Drexel-Morgan interest bought the most Western Union on Monday and the succeeding days of the week. The great manipulator in this stock in times of activity is Mr. S. V. White. During the period under review his attention has been confined almost wholly to the gigantic deal which he so successfully worked in Sugar. This perhaps accounts for inactivity in Western Union and its slightly declining tendency. If there is no onslaught made on the stock by the bears next week, it will probably maintain its present quotations as long as general market conditions are unchanged.

Robert Goodbody & Co., in their market letter, say: "Nothing has apparently benefited more in public estimation by Mr. Gould's death than Western Union. The bulls say that it can earn 6 per cent. on the present amount of stock and that it is to be listed in London. No doubt it may pay 6 per cent. dividends, even on the enormous watering stock, but our London friends will do well to distrust any old established American stock which is newly listed in London, for it indicates that some one here wants to dispose of a block large enough to make a market therewith. We were never tired of writing up Western Union at about 80, but while we know it is probable, or possible, that it may go much higher than it is now Western Union over par with 10 per cent. of water just added, will be a far less desirable purchase. American Cable has at last begun to attract attention. It is a good purchase for permanent investment when selling anywhere under 95.

General Electric.—This stock sold off steadily throughout the week with scarcely a rally. A broker who makes a specialty in this stock says that the sales were on realizations by parties who had secured moderate profits, including the dividend recently paid, and were willing to take the same. Other parties at interest attribute the decline to the new evidence against the validity of the Edison lamp patents presented last week.

In the injunction suit of the Edison company against the Beacon company, before Judge Colt, in Boston, Mr. Kenyon, of New York, in his argument for the defendant, insisted that the proof was overwhelming that Goebel invented the incandescent lamp long prior to Edison's invention of it in 1879. Mr. Seward, of New York, and Mr. Fish, of Boston, in the closing arguments for the Edison company, insisted that it was improbable that Goebel invented the lamp prior to Edison, and urged the court to grant an injunction or restraining order immediately. This Judge Colt declined to do, and at the request of the defendants he allowed a week for printing the papers and filing briefs. This is regarded as significant as showing that the court attaches serious importance to the defendant's claim that Goebel was the prior inventor of the lamp.

Edison Electric Illuminating Company, of New York.—The strength in this security is due to the steady inquiry, which is very widespread, for both the stocks and the bonds in the company, based upon the excellent showing made by the annual report published exclusively in THE ELECTRICAL WORLD last week. The highest quotation reached was 125, at which the stock closed. The week was a banner one for bond sales, as is noted elsewhere. The Governing Committee of the New York Stock Exchange recommends that the Edison Electric Illuminating Company, of New York, be allowed to list on the New York Stock Exchange $150,000 additional first mortgage 5 per cent. convertible gold bonds, Nos. 3,101 to 3,250 inclusive, being added to the amount now on the list, making total amount listed to date $3,250,000. Also that on Feb. 3, 1893, $400,000 additional capital stock be added to the amount now on the list, making a total listed to date of $6,500,000.

The Interior Conduit and Insulation Company.—This stock received limited transactions through a range of 66 to 67½. The stock is now regularly listed on the New York Stock Exchange. It has 12,500 shares, par value $100 each, fully paid. It has no bonded debt save $75,000, purchase money mortgage on its taxes. It has no floating debt of any kind save the current monthly account payable for supplies, etc. The earnings of the company for eleven months from Jan. 1, 1892, were as follows:

Gross, Conduit department	$190,660.46
" Electric manufacturing department	136,848.47
Total	$327,508.93
Cost of manufacturing and general expenses	258,583.00
Net profit eleven months	$68,924.00

CONDENSED BALANCE SHEET.

Assets.

Real estate, buildings, plant, etc	$311,960	
Stock and supplies on hand	113,422	
Cash, bills and accounts receivable	83,129	
Patent accounts	877,742	
Experimental account	38,018	
Sundry accounts	18,677	
		$1,462,951

Liabilities.

Capital stock	$1,250,000	
Mortgage on buildings	75,000	
Accounts payable	43,054	
Bills payable	40,809	
Profit and loss	54,087	
		$1,462,951

This company has paid no dividends, having used its net earnings for improvement and development of plant, etc. The Board of Directors, elected Feb. 26, 1892, consists of Edward H. Johnson, president, New York; Everett W. Little, vice-president, New York; Edwin T. Greenfield, New York; Carl Schurz, Pocontico Hills, Westchester county, N. Y.; Charles E. Runk, New York; Frank J. Sprague, New York; Henry Steers, New York; J. B. Skehan, New York. The officers of the company are Edward H. Johnson, president; E. W. Little, vice-president and general manager; Charles P. Geddes, secretary and treasurer; transfer office, the company's financial and executive office, Edison Building, No. 44 Broad street, New York City; registrar, Central Trust Company.

Cleveland Telephone, Northwestern Exchange and Southwestern Telegraph and Telephone Company's report for the quarter ended Dec. 31 shows: Gross earnings, $241 815; increase, $19,329; net above expenses and dividends, $14,320; increase, $5,695. The Erie company received $57,080 dividends from the above, increase $2.85, and paid $48,000 each year leaving surplus, $9,080; increase, $2,085. Total surplus for quarter, $23,400, increase, $7,780; 343 new subscribers were connected; increase, 65; total number connected, 15,070; increase, 1,059; nine months' surplus earned, $25,211, increase, $8,893, and total surplus, $52,087; increase, $11,829.

WALL STREET NOTES.

The gross output of the Bell Telephone Company for the month ending Jan. 20 was as follows:

	1892-3.	1891-2.	Inc.
Gross output	7,121	5,633	1,488
Returned	4,896	4,236	660
Net	2,225	1,397	828

Adrian H. Muller & Son sold at auction Tuesday 143 shares of the Citizens' Electric Illuminating Company of Brooklyn at 166; 100 shares of the Syracuse Consolidated Street Railway Company at 13.

The New England Telephone and Telegraph Company has declared a dividend of 1¼ per cent., payable Feb. 15, to stock of record Jan. 31. Books close Feb. 10 to Feb. 15.

The Lancaster & Philadelphia Electric Street Railway Company has been incorporated with a capital of $1,500,000.

A Chicago dispatch says: The National Electric Construction Company filed an intervening petition in the case of the Edison against the Sunbeam Incandescent Lamp Company, asking that the Edison company be restrained from monopolizing the market and that it be compelled to sell lamps to all who may apply, and that the restraining order recently issued against the Sunbeam company be modified so as to permit it to sell lamps to the National Electric Construction Company. The court granted the request temporarily, and ordered the Edison company to supply lamps.

The Boston "Traveller" says: "It is rumored in local financial circles to-day that a big electrical railway scheme is on foot which will take in Needham, Millis, Medway, Franklin, Holliston, Walpole, Dedham, Wellesley, Medfield, and numerous other towns in that section. The line will, it is said, really extend from Boston to Pawtucket, and the company that will build and equip it will have a capital of from $2,000,000 to $3,000,000.

The Thomson-Houston Company, of Chicago, Ill., filed an application in Little Rock, Ark., for the appointment of a receiver for the City Electric Street Railway Company.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Jan. 28, 1893, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel.	100	3,825,000	56	57½	56	58
American Tel. & Cable	100	14,000,000	90	91	90	91½
Central & So. Am. Tel.	100	6,500,000	....	....	110	117
Commercial Cables	100	7,716,000	....	....	170	185
Gold Stock & Tel	100	5,000,000	....	....	100	103
Bonds	500	500,000	....	....	....	....
Franklin	100	1,000,000	....	....	35	40
Mexican Telegraph	....	2,000,000	....	....	180	200
Northwestern Telegraph	....	2 500,000	....	....	102	105
Postal Tel. & Cable	....	10,000,000	....	....	81½	82½
Southern & Atlantic Tel	25	948,775	....	....	78	83
Western Union Tel	100	94,820,000	98½	100⅝	98¾	99
Real estate bonds	1,000	1,219,000	....	....	....	....
Debenture bonds	1,000	4,920,000	106	106	105¾	106
Collateral Trust 5's	1,000	8,181,000	104½	105	....	....
North American	100	39,767,200	11¼	11⅝	11⅜	11¾
Brush Ill. Co. of N. Y.	50	1,000,000	....	....	25	30
Edison El. Ill. of N. Y.	100	6,100,000	124	125¼	124	125
" " 1sts	....	.....	118¾	120¼	....	
" " Deb's	....	.....	....	....	....	....
Edison El. Ill. of Brooklyn	100	1,500,000	....	....	115	120
" " " " Chicago	100	750,000	....	....	170	180
" " " " Boston	....	.....	....	....	130	140
" " " " Philadelphia	....	.....	....	....	130	131
Edison El. Lt. Europe	1,000	2,000,000	....	....	2	6
" Bonds	....	30,000	....	....	80	85
Edison Ore Milling Co.	....	2,000,000	....	....	12	17
East River El. Light	100	1,000,000	....	....	....	65
Fort Wayne Electric	....	.....	....	....	13	13¼
General Electric	1,000	30,395,600	113	109½	110¾	111¼
Debenture 5's	....	10,000,000	100¾	101	100½	101
Automatic Exhibition Co.	....	2,500,000	....	....	3	5
Interior Conduit & Ins. Co.	100	1,250,000	66	67¼	66	68
Mt. Morris Electric	....	500,000	....	....	....	65
N. E. Phonograph	....	2,000,000	....	....	2	4
N. Y. Phonograph	....	2,000,000	....	....	2	5
N. American Phonograph	....	2,000,000	....	....	4½	6
Westinghouse E. & M. Co. 1st p. 7 per cent., Cum.	50	3,755,700	....	....	....	....
E. & M. Co. Assg	50	5,333,940	....	....	....	....

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stocks furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago	200	210	Chicago Light and Power Co.	....	117½
Central Union	53	56	Chicago Edison Co	190	....

NEW INCORPORATIONS.

The Columbus Electric Company, Columbus, Kan., capital stock $10,000, has been formed to furnish electric light. B. F. Hogg and E. M. Tracewett are interested therein.

The Colorado Electric and Gas Company, of Denver, Colo., has been formed to manufacture electricity and gas. The organizers are W. H. James, Owen Allen and Harry C. James, of Denver.

French's, of Evanstown, Ill., capital stock $50,000, has been incorporated to produce and supply electric light, heat and power, etc. O. Clinton French, W. J. Bergeren and A. W. Underwood are the incorporators.

The Lakeside Railway Company, of Shenandoah, Pa., capital stock $50,000, has been formed to construct and operate an electric railway. O. A. Keim, J. A. Grant and B. J. Yost, all of Shenandoah, are the promoters.

The Chestatee Company, of East St. Louis, Ill., capital stock $100,000, has been formed to supply electric and other power, mine, etc., in Georgia. Jas. D. Thompson, Alexander Ross and Thomas F. Colfer are the parties interested.

The Willson Company, of Bozeman, Mont., capital stock $75,000, has been formed to operate electric light plants, etc. The promoters are L. S. Willson, F. A. Fielding, C. W. Jackson, and Sherman G. Phillipps, all of Bozeman.

The Terminal Land and Milling Company, of Everett, Wash., capital stock $100,000, has been formed to deal in electric light plants, water-works, gas works, etc., etc. G. A. Pounder and Edward Mills, of Everett, are the promoters.

The Illinois Municipal Improvement Company, Bloomington, Ill., capital stock $50,000, has been formed to equip, maintain and operate electric light and water works. C. F. Mills E. B. Hilliman and F. J. Fitzwilliams are the promoters.

The Southern Electric Railroad Company, of St. Louis, Mo., capital stock $1.500,000, has been incorporated to operate street railways. Tom L. Johnson, Cleveland, O.; J. C. Richardson and E. S. Lovejoy, both of St. Louis, Mo., are the promoters.

The Wissinoming, Bustleton & Somerton Railway Company, of Bustleton, Pa., capital stock $48,000, has been formed to construct and operate an electric railway. Geo. A. Castor, Alex. K. Pedrick and Thos. Shallcross are the organizers.

The Union Street Railway Company, of Freeland, Pa., capital stock $18,000, has been formed to construct and operate an electric railway in Luzerne County. The incorporators are E. G. Wightman, Fred. W. Bleckley and Horace E. Hand, of Scranton, Pa.

The Jenkintown Electric Railway Company, of Jenkintown, Pa., capital stock $150,000, has been formed to construct and operate an electric railway in that town. Oscar H. Weidemann, W. S. Watson and S. W. Wilson are the incorporators.

The Independence Gas and Electric Company, of Independence, Ia., capital stock $50,000, has been formed to manufacture and supply electricity for light, heat and power. C. D. Jones, S. B. Hovey, I. V. Tabor, R. M. Campbell, all of Independence, are the promoters.

The Oliphant & Winton Traction Street Railway Company, of Winton, Pa., capital stock $36,000, has been formed to construct and operate an electric railway in Lackawanna county. The promoters are Julius Moses, J. N. Lillibridge and R. J. Gallagher.

The Schuylkill Valley Illuminating Company, of Philadelphia, Pa., capital stock $30,000, has been formed to supply light, heat and power by electricity. The organizers are L. Knowles Perot, Wm. C. Haines, Philadelphia, and Francis Fenimore, of St. Davids, Pa.

The Lancaster & Middletown Railway Company, of Lancaster, Pa., capital stock $500,000, has been formed to construct and operate an electric railway from the one town to the other. J. W. B. Bausman, John A. Coyle and Jacob B. Long are the parties interested.

The Lackawanna Street Railway Company, of Lackawanna, Pa., capital stock $60,000, has been formed to construct and operate an electric railway in Lackawanna County. J. A. Gillick, Jas. Butler, Minooka, Pa., and J. W. Houser, of Taylor, Pa., are the promoters.

The Everett Railway and Electric Company, of Everett, Wash., capital stock $200 000, has been formed to build, equip and operate street and other railways, electric light and power plants, etc. The organizers are Geo. S. Brown, Schuyler Duryee and F H. Brownell, all of Everett.

The Electric Railway Switch Company, of Portland, Me., capital stock $400,000, has been incorporated to manufacture and deal in all kinds of electrical and mechanical apparatus. J. E. DeWitt, J. B. Kehoe, and J. H. Drummond, Jr , all of Portland, are those directly interested.

The San Francisco Electric Company, of San Francisco, Cal., capital stock $100,000, has been formed to generate electricity for light, heat and power, and to deal in machinery, etc. J. C. Gardner, C. S. Wright, H. R. Gates, J. F. Myers and M. E. Monroe, all of San Francisco, are the promoters.

The Electric Corporation, of Portland, Me., capital stock $1,000,000, has been formed to manufacture and deal in electrical instruments and equipments of all kinds. Allston Burr, Newton, Mass.; Simon G. Croswell, Cambridge, Mass , and Jas. H. Cutler, Boston, Mass., are the parties interested.

The Westchester & Long Island Tunnel Railroad Company, of New York, capital stock $100,000, has been formed to operate a tunnel railroad by electricity or steam. Frederick Cook, Orange, N. J.; Henry M. Conover, Brooklyn, N. Y., and Everett R. Reynolds, New York, are the incorporators.

The Susquehanna Valley Electric Traction Company, of Waverly, N. Y., capital stock $20,000, has been formed to construct an electric railroad. A. N. Broadhead, 508 Main street; Chas. M. Dow, 72 Allen street, and S. B. Broadhead, 101 East Fourth street, all of Jamestown, N. Y., are the promoters.

The Electrolier Manufacturing Company, of Pittsfield, Mass., has been organized with an authorized capital of $100,000; Wm. M. Wells, is president; Harry D. Sisson, secretary and treasurer and business manager. This new company will manufacture the Sisson automatic electrolier and other electrical appliances.

AFFAIRS OF THE COMPANIES.

Mr. George F. Haven, draughtsman, of 10 Park Place, reports renewed activity in engineering, mechanical and railroad industries.

The East End Street Railway, of Bridgeport, Conn., was recently sold to Col. N. H. Heft, representing a syndicate of New York parties. A new directory was elected as follows: Colonel Heft, president; Wm. Scheerer, treasurer; G. O. Lines, secretary and general manager, and T. B. Lashar superintendent. The price paid for the property was $600,000. Offers have also been made leading toward securing the Bridgeport Horse Railroad Company.

The Columbian Emery Wheel Company, with $6,000,000 capital, was organized under the laws of the State of New Jersey at Trenton, on Thursday, Jan. 12, 1893, with the following directors: Frederick S. Dickson, Philadelphia, Pa.; F. H. Pietsch, Chicago, Ill.; L. Best, New York, N. Y.; C. Ross Grubb, Camden, N. J.; Clarence Tebbets, Waltham, Mass.; F. R. Preston, Detroit, Mich.; Harlan Page, Philadelphia, Pa.; Geo. Maitland, Detroit, Mich , and Geo. W. Jackman, Bridgeport, Conn. The officers of the company are Frederick S. Dickson, president; F. H. Pietsch, vice-president; L. Best, secretary, and F. R. Preston, treasurer.

The annual report of the Chicago City railway shows that of the total revenue 66.46 per cent. was from cable lines and 33.54 from horse car lines. The net profit for 1892 was 19.01 per cent. on the capital, against 17.27 per cent. for 1891. The figures follow:

Year.	1892.	1891.	Increase.
Earnings	$4,400.944	$3,873,198	$527,746
Expenses	2,809,431	2,534,315	275,116
Net	$1,591,513	$1 338,883	$252,630
Interest and dividends	1,070,873	966,585	104.288
Surplus	$520,640	$372,298	$148,342

The growth of street car travel in Chicago is shown in the fact that 236,956,792 passengers were transported in 1892, against 207,420,874 in 1891 and 183,331,163 in 1890.

The Chicago Edison company makes this report for 1892:

Gross earnings, all sources	$872,665
Expenses	551,609
Net earnings	$321,056
Brought forward from last year	244,000
Total available for dividends	$565,056
Dividends paid	90,000
Carried forward	$475,056

The net earnings of the company were as above, $321,000, which is at the rate of 32 per cent. on the capital with which the company started in the year, and at the rate of 21 per cent. on the present capital. The capital was increased from $1,000,000 to $1,500,000 during the latter part of 1892. The company was organized in 1887 with a capital of $500,000. This was increased in 1890 to $750,000, and again increased in 1891 to $1,000,000, at which point it stood during most of the year 1892. The company has outstanding bonds to the amount of $130,300. The number of incandescent lights connected with the system is 99 225. Motors are operated to the amount of 2,044 h. p. The sum expended during the year for additions to the plant was $385,000. Extensions and enlargements of plant are projected at an expense of $1,180,000. This company will acquire control of the Chicago Arc Light and Power Company, said to be earning $150,000, or 8 per cent, on its stock, thus giving it a monopoly in the city.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Jan. 30, 1893.

The Union Telephone Company, formerly of 64 Broadway, New York City, has removed its offices to 50 Broadway.

The New England Trust Company has been appointed the transfer agent in this city for the Westinghouse Electric Company assented and preferred stock. The transfer books will be opened Feb. 1.

Mr. H. W. Weller, of the New York office of the Railway Department of the General Electric Company, has been in charge of their railway supply house in New York since Dec. 1 last. Since he has had this department under his care the results obtained have been more than satisfactory.

ALBANY, Jan. 28.

Chatham, N. Y., is to have an electric fire alarm system.

Frank E. Page has been appointed acting superintendent of the Chatham electric light works.

A renewal of the contract to light the streets of the village of Hoosick Falls has been given to the Electric Light and Power company of Hoosick Falls.

The National Storage Battery Company has elected the following directors: C. M. Ball, E. G. Bernard, Geo. W. Dow, W. H. Hollister, Jr., Nelson Davenport, and W. D. Wheeler.

The quarterly report of the Mohawk and Herkimer Street Railroad Company, with offices at Mohawk, shows the net income to be $1,359.16. The Cooperstown and Charlotte Valley Railroad's net income was $556.87.

The Central & South American Telegraph Company has filed with the Secretary of State a certificate showing that its capital stock has been increased from $6,500,000 to $8,000,000. The amount of capital actually paid in is $6,308,000.

The Proposed Cayadutta Electric Railway.—The work on the Cayadutta Electric Railway has been progressing notwithstanding the extremely cold weather. Considerable trouble has been experienced by the road at Gloversville, but the company has persevered and the work is now nearly completed.

An electric railroad connecting Beaver Falls and Castorland and eventually extending to Croghan and Carthage is talked of. H. Walter Webb says that should the citizens decide to build the electric railroad to connect with the Rome, Watertown and Ogdensburgh railroad at any point, the iron for the electric road will be furnished free.

The Glens Falls, Sandy Hill & Fort Edward Electric Street Railroad Company reports for the quarter ending Dec. 31, 1892, as follows: Gross earnings, $8,881.93; operating expenses, $5,471.84; net earnings, $3,409.89; other income, $48 52; gross income, $3,458.41; deduct, $1,728; net income, $1,730.41. The mammoth snow plow made at the Sandy Hill iron and brass works has been received.

The Troy & Lansingburgh Railroad has elected the following directors: William Kemp, Charles Cleminshaw, Otis G. Clark, Joseph B. Carr, Edward Murphy, Jr., Anthony N. Brady, James O'Neil, Peter McGrath, William Shaw, Charles G. Cleminshaw, William Kemp, Jr., Edward Murphy, 2d. These officers were elected: President, Charles Cleminshaw; vice-president, Joseph B. Carr; secretary and treasurer, J. J. Hagen.

Governor Flower is greatly interested in the plan to operate the state canals by electricity. He believes that these inland waterways can be equipped with the single trolley overhead system for $1,000,000. He maintains that by this system boats could be rushed through from Albany to Buffalo at 60 cents a day. In his estimate of $1,000,000 the governor figures the cost of poles, trolley wires and power houses at Albany and Buffalo and 12 intermediate plants. The electric system would entail an outlay of from $150 to $200 for the necessary machinery from each boat.

The Troy City Railroad has elected the following directors: William Kemp, Charles Cleminshaw, Otis G. Clark, Joseph B. Carr, Edward Murphy, Jr., Anthony N. Brady, James O'Neil, Peter McCarthy, Thomas Breslin, William Shaw, D. J. Whelan, Clarence N. Flack, and Francis N. Mann. Inspectors of election: Charles G. Cleminshaw, William Kemp, Jr., and Edward Murphy, 2d. The following officers have been elected: President, Charles Cleminshaw; first vice-president, Anthony N. Brady; second vice-president, Joseph B. Carr; secretary and treasurer, J. J. Hagen.

The Buffalo & Tonawanda Electric Railway Company has filed its certificate of incorporation. Its capital stock is $100,000 and its business is to maintain and operate a street railroad from the Military Road at the northerly city line to Sweeney street in North Tonawanda. Frederick Swift, Charles A. Lehritter, Wendell Goodwin, and L. O. May, of New York; W. P. Whitlock, of Elizabeth, N. J.; G. H. Wirth, of Brooklyn; Francis Gilbert, of East Orange, N. J.; and W. Carl Ely and Frank A. Dudley of Niagara Falls are named as directors for the first year.

The new power station of the Albany Railroad is now supplying the electrical current that moves the motor cars over all the lines. The new power house is situated on South Pearl street and two of the largest dynamos made have recently been added to the plant. This will do away with the power house on Broadway, from which the motive power for the Broadway division was obtained. These new dynamos are what are known as multiple type machines and were manufactured by the General Electric Company. They have a capacity of 750 h. p. The total capacity of the nine old dynamos is 720 h. p. Besides the new dynamos the Albany Railway has put in two 250-h. p. Corliss engines of the latest improved type. Four new Babcock & Wilcox boilers will generate the steam for each of these engines, each boiler being 125 h. p The plant was erected under the direction of Mr. Frank F. Goodwin, of the Thomson-Houston company. It is now one of the best equipped in the country.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 31, CITY TRUST BUILDING, 927 Chestnut St.,
PHILADELPHIA, Pa., Jan 28, 1893.

C. H. & H. Staunton, electrical contractors and supply dealers, 134 South Third street, Philadelphia, have been overrun with work for the past few weeks. They have contracted for the wiring of fifty houses in Allegheny, Pa.; they have orders also for about fifty electroliers, most of which are from Pittsburgh. The designs of some of these electroliers are certainly very beautiful.

The Crandell Manufacturing Company, manufacturers and dealers in electrical supplies, 12 South Fourth street, Philadelphia, report business very good. The miniature electric street railway in operation in the window of this firm, after the plan of the elevated electric railway which will be in operation at the World's Fair, is a very novel feature and attracts much attention from passers by.

The Laroche Electrical Works recently installed an electric plant in the Winter Circus Building, Philadelphia, which is indeed worthy of mention. This plant consists of about 700 incandescent lights, half of which are used at one time, and 400 arc lights; one compound incandescent 300-light dynamo and two 20-light arc machines. The incandescent lamps are of four different colors, viz.: red, white, blue and green. An electrolier, 45 ft. in diameter, suspended from the dome of this building, is said to be one of the largest ever made. The automatic switchboard, which is placed in an underground passage, is new and novel in construction, and is so arranged that it can be manipulated so as to produce any colored light or combination of colors desired, the effect of which is very beautiful. The wiring is of the most modern plan. The concealed wires are placed in tubings and moldings made especially for this purpose. All the cut-outs which control the lights throughout the building are placed in boxes underneath the ground, hence in case of a blow-out or short circuit the operator can replace them without causing any interruption.

WASHINGTON NOTES.

WASHINGTON, D. C., Jan. 28, 1893.

An Isolated Plant.—A new C. & C. dynamo and Buckeye automatic engine have just been installed in Hotel La Normandie. The capacity is for 150 incandescent lamps of 16 c. p. each.

Saks & Co., large retail clothiers of this city, have contracted with the Mather Electric Company, of Philadelphia, for the installation of electric lighting apparatus. The plant will furnish some 65 arc and 500 incandescent lamps.

The new storage battery cars of the Metropolitan Railway Company were furnished by J. A. Trimble, New York City, and are of very neat design. The seats and backs are made of woven rattan, while the extremely large windows are fitted with patent curtains.

Colonel D. Anderson, of this city, has accepted the position of attorney for the Mount Vernop Electric Railway Company, of Alexandria, Va. Mr. H. S. Cooper, formerly manager of the Winston-Salem, N. C., electric railway, has accepted the management and entered upon his duties on the 24th inst.

Mr. J. Hite Miller, President of the Tennallytown Electric Railroad, after a successful term of management, covering the past four months, has been retired, and is succeeded by Mr. M. Wilson Offutt. It is reported that the reason of this change was due to the unwillingness of Mr. Miller to run the Tennallytown road in the interest of the Bethesda line. Among the directors of the first named are those who control stock in the latter.

The possibility of having another line of railway betwen this city and Alexandria, Va., which is the object primarily sought in the bill introduced in the House of Representatives to authorize the Washington, Mount Vernon and Alexandria Electric Railway Company to construct a bridge across the Potomac River and a railroad over the same to run through certain streets and reservations of Washington, is looked forward to with great interest by people who find it necessary to travel between the two cities. A liberal feature, decidedly in contrast with the legislative proposition of the Pennsylvania Railroad Company, in connection with the structure which must soon supplant Long Bridge, is the provision which makes public, free of cost, a carriage and footway on each side of the tracks on the bridge.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Jan. 28, 1893.

The Pennock Battery Electric Light and Improvement Company, according to the Boston *Advertiser*, is to locate at Bridgeport, Conn. It would seem that this "Wandering Jew" has at last found his Mecca.

The Nantucket Electric Company is erecting poles on Main street, Nantucket, Mass., and will extend the system to individual users, as up to the present oil has been the sole luminant. The decided improvement is looked forward to with pleasure.

Mr. H. S. Gear, the announcement of whose marriage was given in THE ELECTRICAL WORLD of Jan. 21, 1893, is not the representative of the Eddy Electric Manufacturing Company, as was there stated, but represents D. P. Gosline, 30 Oliver street, Boston, Mass., who is the agent for the Eddy company.

Cumner, Craig & Co. have recently opened offices in the John Hancock Building, Boston, Mass., and have secured the New England agency for the Crocker-Wheeler motor. The excellent reputation that this motor has in this district, coupled with the business abilities of this new firm, should guarantee success.

President Olmstead, of the Springfield Street Railway Company, this State, is preparing to build a power house to furnish power for his system. Such power is now being furnished by the Electric Light Company of that city which for the present is satisfactory, but when the proposed extension is completed it will require considerable more power.

PITTSBURGH NOTES.

PITTSBURGH, Jan. 28, 1893

The Standard Underground Cable Company held the annual meeting of its stockholders last Tuesday. The reports presented are summarized as follows:

Business of 1892	$621,290.81
Stock carried over at cost	78,139.08
Total	$699 429.89
Factory and construction cost	548,564.27
Factory and construction profit	$150,865.62
General expenses	56,331 84
Net earnings	$94,533.78

The balance sheet of the company, so far as the quick assets and leading liabilities are concerned, is as follows:

AVAILABLE ASSETS.

Cash	$13 006 92
Bills receivable	146,797.22
Accounts receivable	162,171.71
Stock on hand at cost	78,139.08
Consignments on hand at cost	2,412.68
Total	$402,527.61

LIABILITIES.

Accounts payable	$56,393.17
Bills payable	95,500.00
Mortgage payable (Brinton property)	22,000.00
Available surplus	228,634.14
Total	$402 527.61

At present the company has only $5,000 worth of accommodation paper outstanding, and the interest and discount account shows a

credit balance of $3,130.77. During the year four quarterly dividends of one and one-half per cent. were paid, aggregating $60,000, and items properly chargeable to 1892 business, amounting to $2,711.74, were paid, so that the net addition to the surplus account was $31,822.04, making the total surplus Dec. 31, 1892, $401,035.54. The year's shipments amounted to $97,303 59 more than in 1891, in addition to which the company brought over into 1893 unfilled orders aggregating $184,000. A favorable space of 600 sq. ft. in the Electricity Building of the World's Fair has been assigned to the company by the committee having the matter in charge, wherein a grand exhibit of its products will be made. The election resulted in the re-election of the old Board of Directors, as follows: George Westinghouse, Jr., Mark W. Watson, John H. Dalzell, James H. Willock, John B. Jackson, George B. Hill, John Moorehead, Jr., Robert Pitcairn and Joseph W. Marsh.

In addition to the already excellent electrical appliances in the fire department at City Hall, a new register and also a repeater, said to be by far the finest pieces of mechanism in the country, as well as some new electrical improvements, are being put in, all of which it is expected, will be in working order in two weeks or so.

A number of well known electricians from abroad on Wednesday made an inspection of the electrical department of the fire alarm, including George F. Porter, secretary of the National Electrical Association of New York; Cyrus O. Baker, Jr., of Baker & Co., Newark, N. J.; S. A. Chase, of the Western Electric Company of New York, and Richard B. Green, superintendent of the Edison Electric Company of Altoona, Pa.

Schenley Park, in this city, will have an electric fountain this summer, which has been donated to the city by the Philadelphia Traction Company, the latter owning a controlling interest in the Pittsburgh Traction Company. The fountain will be 100 feet square, 35 feet high and the most elaborate in the country. Its construction will be patterned after the famous electric fountain in Chicago.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Jan. 21, 1893.

Dr. John McKinlock has been appointed medical director in Chicago for the Commercial Alliance Life Insurance Company of New York.

Mr. Wm. H. McKinlock, president of the Central Electric Company, has just returned from a short trip in the East, where he has perfected arrangements for the introduction and sale of several new specialties.

The Central Electric Company, in preparation for the spring trade, is looking about for new quarters in which to house the large stocks of supplies which its increasing business compels it to carry. It reports several large buildings in view which will enable it to handle its stock with increased facilities.

The Electric Appliance Company is just receiving its first large shipment of its new lamp sockets, to be known as the "Acme." While the socket has no peculiarly startling features it has a number of improvements over others in small details, such as an increased amount of room for the wiring cord, extra long contact screws for securing the cord, and a heavy and handsome shell.

CLEVELAND, O., Jan. 28, 1893.

The Society for Savings Building will have its isolated plant in operation shortly.

The steamers Alpena and City of Mackinaw have recently been equipped with electric lighting plants consisting of direct connected double engines and dynamos.

The Graves Electric Company, of this city, has made an assignment, and is now endeavoring to straighten out its affairs. Its place is, at present, temporarily closed for inventory.

The Ohio Construction Company has opened its office at 54 Franklin street, and started into work in good earnest. The manager, Mr. H. L. Browning, announces that the company is now ready for business.

The Cuyahoga Building is being equipped with an insulated plant consisting of Edison machines. It is being wired by the Cleveland Electric Supply Manufacturing Company. The wires are being laid in open moldings, so as to be easily accessible, and taped Grimshaw is being used for the most part.

The Woodland Avenue & West Side Road is making rapid progress with its power station on the flats. They have already started one engine and two generators, which are furnishing power for the Lorain street portion of the road, while the remainder is running upon rented power. There are some twenty motor cars of the accelerated type running alternately with the horse cars, and everything points to the early completion of the entire plant. The triple expansion condensing marine engine is coming up to its duty in a most desirable manner, and the whole station, when completed, will be a model of good design and convenience.

At the regular meeting of the Electric Club on Jan. 18 a very interesting paper was read by Mr. Hoag, the city electrician, on interior wiring. Mr. Hoag's long experience in practical electrical work pre-eminently fits him to give advice in this line. In talking of the character of insulation he mentioned the rapid deterioration in the covering of poor grades of rubber-covered wire, and also drew attention to the danger from electrolytic action due to leaks upon the conductor, mentioning that defects so small as to be hardly noticeable, even with the aid of delicate instruments, would in time lead to very serious consequences He showed one sample of a large stranded conductor, which had been entirely severed in this way. Particular attention was also drawn to the desirability of designing buildings with a view to convenience and the accessibility of wiring Mr. Hoag closed his remarks with a little experiment demonstrating the inflammable character of many insulations. He had strung across the room a number of specimens of No. 18 insulated wire fastened together in series. Through these he turned a current of about 40 amperes, and upon applying the flame of a match, the insulation on all but two or three of the specimens became ignited. The discussion on the paper was quite lengthy, and was participated in by quite a number of the members, among them Profs. Langly, Morley and Roberts and Mr C. W. Wason. The lack of reliability of fuses was considered at some length, and Prof. Langly gave some very interesting experiences of his own, concerning the crystallizing of wire which had been in use for some time.

TACOMA, WASH., Jan. 23, 1893.

H. T. Purdy, of St. Paul, has been appointed general superintendent of the Tacoma Railway and Motor Company. He will have charge of the main lines, track and motors. He was for a long time an inspector for the Edison company.

Mr. F. T. Blunck, of Davenport, Ia., has been elected president of the Seattle Consolidated Street Railway Company. He is the largest individual stockholder in the company. He is now in Seattle, and will remain several months.

Reed & Co., of Tacoma, have taken the Pacific coast agency for the Toledo Electrical Heating Company, of Ohio. Sub-agencies will be established at several points on the coast by Reed & Co., who have several stoves on exhibition. They also have several car heaters on trial with Seattle street car companies.

S. H. Pierce, formerly connected with the Northwest General Electric Company, has arrived from Butte, Mont., and assumed the duties of general manager of the Tacoma Railway and Motor Company, to which position he was appointed following the resignation of L. H. Griffith. He has had wide and varied experience in electrical work in St. Paul and other cities.

C. S. Clark, of Kansas City, has been elected general superintendent of the Seattle Consolidated Street Railway Company. He has held similar positions in Kansas City, and Augusta, Ga. He will make an examination of the street railway situation in Seattle, where the efforts to combine interests have failed so far, causing too severe competition, there being 102 miles of single track line. He will endeavor to solve the problem.

President John I. Sabin, of San Francisco, recently made an inspection tour of the telephone lines of Washington and Oregon for the Sunset Telegraph & Telephone Company, visiting Portland Ore., and Tacoma, Seattle, Spokane, Everett and Whatcom, Wash. While in Tacoma, he stated that his company would give the Puget Sound cities telephone connection with Spokane, a distance of about 450 miles via Portland, Ore. The gap between Spokane and Portland will be closed up by the Inland Telephone Company, of Spokane, and the Oregon Telephone Company. The Sunset Company owns a controlling interest in the other two.

The Seattle Consolidated Street Railway Company has made sweeping changes in its board of directors, and at the recent annual meeting of the stockholders the following were elected: Jacob Furth, Wm. D. Wood, F. T. Blunck, of Davenport, Ia; V. Hugo Smith, A. Dunn, F. Fonda, of New York, and C. S. Clark, of Kansas City. The trustees have elected as officers: President, F. T. Blunck; vice-president, Jacob Furth; secretary, V. Hugo Smith; treasurer, R. P. Spencer; auditor, A. Dunn; general superintendent, C. S. Clark. The office of general manager has been abolished. The changes have been made with the idea of letting the Eastern stockholders try to manage the company, there being too many competing lines.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Jan. 18, 1893.

National Telephone Company v. Graff Baker.—This action continued to drag its slow length along until yesterday (Tuesday). Several witnesses from America, including Mr. O. T. Crosby, were called, and the decisions in analogous cases in the United States were largely quoted by counsel. There seems some probability that this action will have a favorable termination to electric traction interests.

Electric Traction in England.—Electric traction if developed but slowly in this country is at any rate developing novelties In London we have a tubular railway unique of its kind. In Liverpool we shall in a week or two have an overhead railway on which trains will be run without "locos" and signaling will be carried out electrically and automatically; and now at Brighton it is seriously proposed to run a three-mile line along the foreshore on the extraordinary gauge of 24 feet. This line is to be worked electrically, and apparently high platforms on wheels and not cars are to be used.

Electricity and Wind Power.—England is certainly not a country in which originality is encouraged. A few months ago the London County Council proceeded against an enterprising firm owning a flour mill in the city for erecting a windmill on their roof, partly as an advertisement, and partly to light their premises by electricity. The court decided that the firm had contravened the "Sky Signs Act," but broadly hinted that if the advertisement portion of the windmill were taken down the County Council would have no cause to complain. Now, however, the Ecclesiastical Commissioners, as freeholders of the land, have obtained an injunction restraining the further use of this unfortunate windmill, on the ground that it is an erection contrary to the terms of the building agreement. An interesting experiment is thus prematurely brought to an end, though no doubt Prof. James Blythe will daily continue to grind out his electricity by wind power in Scotland.

Hopkinson Three Wire Patent.—On Saturday morning last Mr. Justice Romer gave a luminous decision in the action brought by Dr. John Hopkinson against the St. James and Pall Mall Electric Light Company for infringement of his three wire patent No. 3,576 of 1882. The court held that the patent was valid, and infringement not being denied the St James Company is now liable to a heavy retrospective fine and, it may be, a heavy prospective tax. However, the St. James Company does not appear to be in any way cast down by the result of this action. The directors in a report published yesterday do indeed regret that the action has been decided against their company, but go on to say that: "Pending the consideration of whether the company should appeal, they are glad to be able to state that they have completed arrangements whereby they will be in a position to continue the supply of current without interruption and without further use of the patentee's system." This reference to an alteration of system points I believe to a proposed ingenious use of secondary batteries. No doubt the comparative jubilation of the infringers is due to the fact that they will not have to bear the whole cost of the action, which was in reality not against the St. James Company, but against all companies using the three wire system and was therefore financed by the Association of Electric Supply Companies. Although one naturally regrets that there should be any probability of an additional burden placed upon the electric supply industry, an industry already much overburdened, nevertheless it is satisfactory that such an excellent patent should be vindicated.

News of the Week.

THE ELECTRIC RAILWAY.

An Electric Railway between Canton, O., and New Berlin is being agitated.

The Jenkintown Electric Railway Company has been chartered at Harrisburg, Pa., capital $150,000.

Terre Hill, Pa.—An electric railroad is to be built from Terre Hill to Mohnsville, Pa., where it will connect with the Reading & Southwestern road, now in the hands of Philadelphians. When this line is completed cars will be run from Reading to Lancasrer without change.

The Lake Roland Elevated Railroad Company has had one of its cars equipped with Burton heaters, which kept the air of the car perfectly comfortable during the coldest snaps. This car is the first of the large contract made by the Lake Roland Company. A new snow plow has also been added to its rolling stock.

Marion, Ind.—A franchise has been granted by the county commissioners for an electric railroad to Gas City, six miles. A bond of $7,000 requires the road to be in operation by July 15. This is the beginning of a system which is expected to connect all the principal points in the Indiana gas field by an electric road. Trips to and from Gas City are to be made every 30 minutes for five cents fare.

Trolley Companies Sued for Infringing.—Notices have been sent to many of the leading street railway companies in the country now operated by the overhead single trolley electric system of suits for infringement of patent rights. The plaintiff is the Sherman Electric Power Company, which claims a priority of patent that affects every user of the single trolley system. The claim is based on a patent granted to W. T. Sherman, of Lowell, Mass., now dead, in 1878, which, it is asserted, covers every device for connecting the car with the overhead wire.

Baltimore, Md.—Owing to the extremely severe weather of the past month all construction work on the various electric railways here has been suspended and as a consequence the new roads will be later in getting into operation. President Perin says his company, the City and Suburban, will have cars running to Towson by May 1 at the latest. It is gratifying to note that the electric roads in the city were the only ones running cars on schedule time during the numerous recent snow storms. The Baltimore and Pikesville road ran its first car over the line on time after the heaviest snow storm of the season, and that even before the snow plow was sent out.

PERSONALS.

Mr. I. N. Neuberger, of the Genett Air Brake Company, 150 Broadway, New York, accompanied by Mrs. Neuberger, is wintering at Aikens, S. C.

Mr. J. W. Godfrey, manager of the New York Insulated Wire Company, 15 Cortlandt street, is in Chicago, where he will remain some three weeks.

Mr. A. G. Waterhouse, of the Waterhouse-Gamble Co., Hartford, Conn., manufacturers of the Waterhouse arc lamp, is in London, Eng., looking after the interest of the company, recently formed in London, to handle his arc lamp.

Mr. Edward Caldwell, after nearly three years' connection with the editorial staff of THE ELECTRICAL WORLD, has resigned his position to enter the field of trade journalism for himself. Together with friends he has acquired a controlling interest in the *Street Railway Gazette*, of Chicago, and will assume the duties of editor of that journal. Mr. Caldwell is well fitted for this work both from an editorial and practical standpoint, and has always taken the greatest interest in it. In addition to his experience on THE ELECTRICAL WORLD, and previously on *Modern Light and Heat*, he was engaged for some time in practical street railway work in the service of the Sprague Electric Railway and Motor Company, and later with the West End Street Railway Company, of Boston, in charge of the electrical equipment of its Brignton division. On Saturday, Jan. 21, Mr. Caldwell's associates on THE ELECTRICAL WORLD presented him with a handsome gold mounted fountain pen as a token of their esteem. His many friends wish him success in his new enterprise.

MISCELLANEOUS NOTES.

The People's Electric Light & Power Company, of Savannah, Ga., will put in a $200,000 plant.

The French Legion of Honor has not waited for Dr. Herz to be extradited. It has tried him in his absence, found him guilty and struck his name off the roll.

Industrial and Trade Notes.

The Electrical Supply Company, of Syracuse, N. Y., is shipping battery cut-outs to all parts of the country.

The Automatic Switch Company, of Baltimore, Md., has removed its offices from 8 Keyser Building to 703 and 705 Equitable Building.

The Waterhouse-Gamble Company, of Hartford, Conn., has recently increased its equipment the better to handle the increasing orders for the Waterhouse arc lamp.

The Southern Electrical Supply Company, of St. Louis, Mo., on account of its increased business, has been compelled to seek new quarters, and its address in the future will be 11 North Seventh street.

Edward C. Bradley, Rochester, N. Y., has removed next door to his old stand (9 Stone street), where he has secured much larger quarters, and will now, in connection with his locksmith and electric bell work, do repairing of armatures and other electrical appliances.

The Esmond Street Rail Company, 106 Broadway, has secured the contract to supply more than thirty miles of its new combination rail in Chicago. This company claims to have solved the much vexed question as to the rail most suitable for electric street railways.

John Loeber and William H. Cooper, of New York City have formed a copartnership to carry on the business of dealing in photographic supplies at 75 and 77 Nassau street, New York City. Mr. Loeber was formerly a partner of the firm of Loeber Bros. and Mr. Cooper has been connected with that firm for the past five years.

The Berlin Iron Bridge Company, of East Berlin, Conn., has received the contract for rebuilding the tube mill of Curtis & Co., at Cohoes, N. Y., lately destroyed by fire. The new plant will be fireproof, constructed entirely of iron and brick, no woodwork being used. The building will be 132 feet wide by 131 feet long, with a wing one side 20 feet wide by 74 feet long.

The Utica Electrical Manufacturing and Supply Company, of Utica, N. Y., is at present very busy, and will soon be obliged to secure the upper portion of the building which it is now in, the dimensions of which are 183 × 34 feet. This company has just shipped two carloads of mast arms and supplies to Cincinnati, O., and reports active sales of its magazine fuse boxes, pole stands, lightning arresters, carbon brush holders, etc.

The Onondaga Dynamo Company, of Syracuse, N. Y., finding its present quarters too small, is now building an addition which will give a space of 146 × 61 feet, and the use of two floors and basement. This company has recently made sales of apparatus of the following capacities: Syracuse Savings Bank, 150 lights; Smith Premier Typewriter Company, Syracuse, 500 lights; D. M. Osborn, Auburn, N. Y., 500 and 300 lights; Batavia Gun Forging Company, 1,000 lights and 200 lights; Wyoming Valley Paper Mill Company, Pittston, Pa., 50 lights, and many others.

The Dewey Electric Heater Company, of Syracuse, N. Y., now has its electric heater in use on 98 different street railways in the United States. The new cars of the Cincinnati, Newport &

Covington road are all equipped with these heaters. The Dewey company has established branch offices at Boston, Baltimore, New York and Chicago. At Toronto, Can., a company is organizing to be called the Dewey Electric Comp ny, to operate the Canadian patent, in which Jas. L. Morrison and S. J. Moore are interested. W. H. Harvey is to be the general manager.

The F. P. Little Electrical Construction and Supply Company, of Buffalo, N. Y., on January 1st succeeded to the business formerly carried on in that city by F. P. Little & Co. The new company will occupy an entire building at 135 Seneca street, a few doors from the old location, and will conduct an engineering and supply business on a considerab'y larger scale than formerly. Mr. F. P. Little, who established the business, will continue as manager and will give personal attention to estimating upon and supervising all the large contracts. In addition o Mr. Little, who is Secretary and eneral Manager, M. P. P. Miller is the President, John L. Williams the Vice-President and F. H. Williams the Treasurer of the new company.

The Onondaga Dynamo Company, of Syracuse, N. Y., has received a letter from E. C. Stearns & Co., of that city, which contains the followi g statements: "As the result of such investigation we were led to place with you an order for one of your 500-light machines. This gave us such entire satisfaction that we gave you an order for an auxiliary dynamo of 50-light capacity, and subsequently substituted one of your plating dynamos for another make in our nickel room. All these machines are giving the best satisfaction. We can say that they range in capacity from 15 to 20 per cent. better than you rate them." Another communication from Crottey & Mitchell, of Weedsport, N. Y., says: "We are pleased to say that the dynamo which we are using and manufactured by you is a very satisfactory machine."

The General Electric Company, through its Syracuse agency, has made the following sales: Perry Electric Light and Power Company, of Perry, N. Y., installation and wiring for 650 incandescent and 50 arc lights; Stanton Courter, Cobleskill, N. Y., 650-light incandescent plant; The Niagara Falls Paper Company, an 800 light incandescent plant; Bastable Block, Syracuse, 1,000 incandescent and 14 arc light plant; T. R. Hazard, Syracuse, 500 incandescent light Thomson-Van Depoele mining plant; Split Rock Quarry, Syracuse, a Marvin drill plant (three drills) and an 18 arc light plant; Yates Hotel, Syracuse, 1,400 incandescent light plant; Cortland Wagon Works, Cortland, N. Y., a 400 incandescent light plant; Troy Malleable Iron Company, a 30 arc light plant; Wayside Knitting Mills, Troy, N. Y., 250 incandescent light plant; Orr's Paper Company, Troy, N. Y., a 250 incandescent light plant; Howgate McCleary Company, Amsterdam, N. Y., a 250 incandescent light plant, and others.

Richmond Mills Sold.—The large Richmond Paper Mills in East Providence, which at the time they were built cost $1,000,000, and which were sold at auction to Charles Fletcher for $42,000 a short time ago, have been bought by the American Electrical Works, of Providence, for an advance over his figures. One hundred thousand dollars had been previously offered by the Van Choate Electric Company, of Boston, this firm having tried to purchase the plant for the manufacture of dynamos. The American Electric Works will use the newly acquired property for the extension of their present business, the manufacture of insulated electric wire. The engines and boilers used by the paper company will be employed by the new owners, and all that remains to be done is to strengthen the floors before the new plant can be put in. Eugene F. Phillips, president of the company, expects that work will commence about the first of June. The heaviest part of the business of this company will hereafter be done at the East Providence branch, and an additional force of 200 men will be employed.

The Wheeler Condenser and Engineering Company Cast a Mammoth Cylinder.—In the presence of a number of prominent contractors, engineers and press representatives, a large cylinder for one of the new Fall River boats was cast at the works of the Wheeler Condenser and Engineering Company, Carteret, N. J., on the afternoon of the 26th ult. This cylinder is believed to be the heaviest ever cast, except for transatlantic steamers. The bore is 95 inches, length of stroke 11 feet, and 60,000 pounds of metal was used in the casting. The cast was quickly and easily made and was a complete success, and the Wheeler Condenser and Engineering Company is to be congratulated upon the result of this important piece of work. This is one of the low pressure cylinders of the new steamer, whose name has not yet been decided upon, which will be running on the Fall River line in the early summer of 1894. The W. & A. Fletcher Company, of Hoboken, who also built the Puritan and Plymouth, are the sole contractors, and have sublet various parts of the contract to other firms. The engine is of the vertical inclined type and is to develop 8,000 h. p. There are two high pressure cylinders of 51-inch bore and two low pressure cylinders of 95, all which are being cast by the Wheeler company Steam will be furnished by 10 three furnace Scotch boilers 14 feet in diameter and 14 feet 6 inches long, at a pressure of 150 pounds. This new steamer is to be 440 feet 6 inches over all, or 20 feet longer than the Puritan of the same line, 423 feet 6 inches at the water line and 92 feet over guards. The displacement at 12 feet water line is 4,600 tons. The hull will be double with a three-foot space between. Accommodations will be provided for 1,400 passengers. The dining room, which will seat at one time 250 people, will be on the main deck instead of below as in other boats. This new steamer will be lighted by electricity, but the details have not yet been decided upon.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filter for sale cheap; send for prices to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

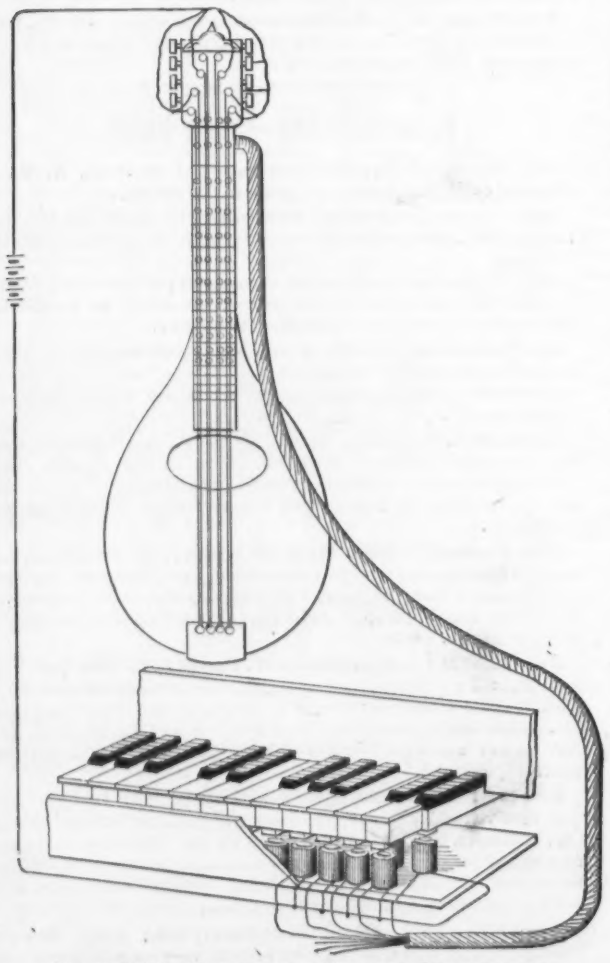
[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

UNITED STATES PATENTS ISSUED JAN. 24, 1893.

490,279. Electric Meter; Oscar Frolich, Berlin, Germany. Application filed Nov. 16, 1892. An electric meter comprising a soft iron bar, capable of oscillating on a central axis, two coils through which the current to be measured, or a fraction thereof, is made to flow, one of them being wound transversely and the other parallel to the bar, and means for alternately reversing the direction of the current flowing through the coil wound parallel with the bar.

490,280. Electric Motor; Julius W. Hansen, St. Paul, Minn. Application filed Sept. 25, 1891. The combination with laterally adjustable stationary field magnets and central revolving armature and commutator of a commutator brush having an outer contact foot pivotally secured to one end, a leaf spring secured to the body of the brush and normally pressing the foot against the commutator and means for adjustably securing the same within one of the frame plates.

490,292. Cut-Out for Electric Circuits; Michael Leavy, Pittsfield, Mass. Application filed June 16, 1892. The combination, with an insulating tube having metallic ferrules or ends formed or provided with lugs or wings, and binding screws for clamping to the ferrules the ends of a safety strip contained within the tube, of metallic terminals provided with spring jaws or clips by which the lugs or wings on these metallic ferrules of ends of safety tube are held.



No. 490,358.—ELECTRICAL MUSICAL INSTRUMENT.

490,297. Electric Railway Conductor; Howard A. Miner, New York. Application filed June 2, 1892. In a trolley railway system a conductor wire, a feeder wire, in combination with each other, and with a partial insulating coating, and with a casing having flanges or lips at its lower edges and partially inclosing both wires.

490,302. Insulator; Louis McCarthy, Boston, Mass. Application filed July 9, 1892. An insulator comprising a case, a headed connecting piece placed thereon, a series of sheets of mica interposed between the head of the connecting piece and the end of the case, to insulate the connecting piece therefrom, and a mass of comminuted mica surrounding the head of the connecting piece to insulate its sides from the case.

490,306. Closed Conduit for Electric Railways; Russell Parker and Benjamin F. Sutton, Brooklyn, N. Y. Application filed Jan. 9, 1892. The combination with an electric conduit of supporting plates having their lower ends engaged with the conduit, their upper ends the one overlapping the other, and means for holding the plates together. (See illustration.)

490,307. Electric Locomotive; Alexander Philipsborn and Max Schiemann, Berlin, Germany. Application filed April 14, 1892. The combination in an electro locomotive car, of traction wheels, truck frame and electro-motor supported by same and movable relative to the traction wheels, means for frictionally transmitting power from the motor shaft to traction wheels, and a car body exerting its weight on the transmission means and elastically supported on the track frame to vibrate independent of the motor.

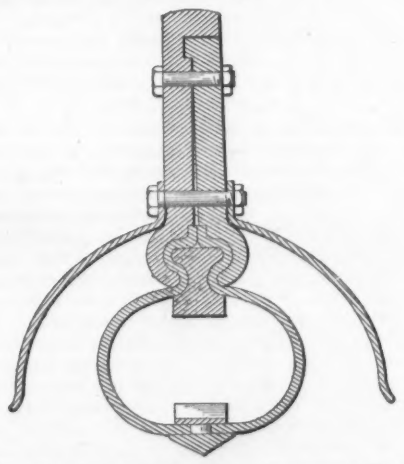
490,326. Locking Hat Rack; Frank B. Trout, Detroit, Mich. Application filed June 13, 1892. In a hat rack, the combination of a holding frame, a locking lever, an actuating wheel actuating this lever, and an interposed link connecting the wheel and lever.

490,327. Electric Annunciator System; Henry van Hoevenbergh, New York. Application filed March 24, 1892. The combination of an electric lamp, circuit-closer for transmitting a current through the lamp, a visual signal which controls the action of the circuit-closer, a device within a room for exhibiting a signal, and a device without the room for reversing this signal.

490,353. Electric Mat; William G. James, Harlem, Ill. Application filed Sept. 29, 1892. An electrical mat consisting of a lower plate provided with upturned flanges at its lower edges, an elastic upper edge having its edges inserted in the flanges, this plate being normally held out of contact with the lower plate and insulating material interposed between the edges of the two plates.

490,358. Electrical Musical Instrument; Anacleto Montanelli, Portland, Ore. Application filed May 31, 1892. The combination of a primary stringed instrument, electrical contacts located beneath the strings, above the keyboard and on the head of the instrument, a secondary instrument and electromagnets controlling the keys, electric circuits connecting the contacts with the respective magnets, the strings of the primary instrument being electrical conductors. (See illustration.)

490,363. Electric Switch; Albert L. Rohrer, Lynn, Mass. Application filed March 17, 1892. The combination in an electric switch of the rotating plate and switch arms pivoted thereto, with pivoted catch released automatically by the movement of the switch arms on opening the switch.



No. 490,366—CLOSED CONDUIT FOR ELECTRIC RAILWAYS.

490,376. Armature for Dynamo-Electric Machines or Motors; Elihu Thomson, Swampscott, Mass. Application filed July 10, 1891. A sectional laminated core for dynamos or motors having overlapping sections, holes through the sections near the inner edge thereof, and binding rods slotted along their length and occupying the holes. (See illustration.)

490,449. Dynamo-Electric Machine; Robert Lundell, Brooklyn, N. Y. Application filed June 21, 1892. An electric motor having a single field magnet coil and an armature, the axis of which is coincident with the axis of the field magnet coil and one or more inwardly projecting field magnet poles located in the annular space between the field magnet coil and the armature.

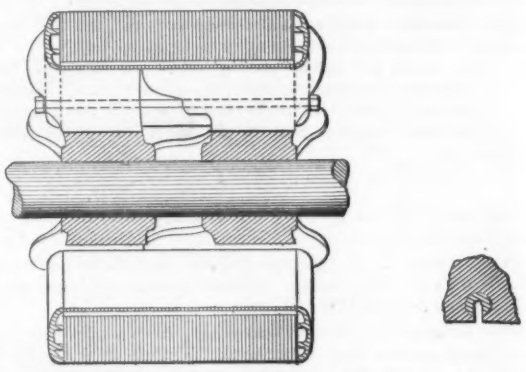
490,460. Dynamo-Electric Machine; Charles Wachtel, Newark, N. J. Application filed July 13, 1892. In a dynamo electric machine, the commutator consisting of porcelain sections having longitudinal slots or openings, each section having an annular portion and an undercut portion, insulated commutator sections between the annular portions, suitable brass rings, and screws or bolts for securing all the parts together.

490,477. Electrical Connecting Device; Joseph Hutchinson, New York. Application filed Sept. 16, 1892. A chambered safety-catch plug carrying exterior switch contacts and having within its chamber a safety-catch link connecting the exterior switch contacts, the plug constructed to form the rotating element of a circuit-making and breaking switch and having a central opening through it adapting it to be readily mounted upon and removed from a rotating switch spindle.

490,479. Electric Show-Case Alarm; R. C. Kruschke, Duluth, Minn. Application filed July 9, 1892. The combination, with a show case tray, of a fixed contact and a movable contact arranged to clasp an article between them and the movable contact be actuated by the article being held and to sound an alarm automatically when the article is removed.

490,560. Insulator; Auguste Joseph Haury, Daltsburg, Pa. Application filed Aug. 29, 1892. The combination, in an insulator, of a threaded standard, the outer cap having its inner periphery threaded oppositely to the standard and provided with a longitudinal slot, and the inner or intermediate cap threaded to register with the threaded portion of the standard.

490,597. Conductor System for Electric Railways; Raphael Hayden, Fairmont, W. Va. Application filed April 13, 1892. In an electric railway system, an insulated conductor connected with a dynamo, a contact conductor which is divided at intervals into sections normally disconnected from the insulated conductor and from each other, and means, including one or more electromagnets, by which, at the time when a current collector passes off of a section preceding a given section, and on to the given section, the preceding section is disconnected from the insulated conductor and a section succeeding the given section is connected with the insulated conductor.

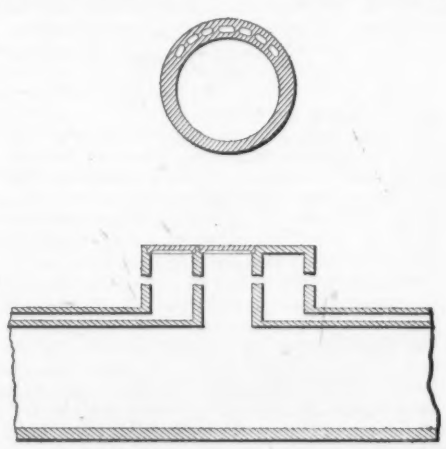


No. 490,376.—ARMATURE DYNAMO ELECTRIC MACHINES OR MOTORS.

490,605. Electric Lamp Socket and Tap; Alexander F. Vetter, New York. Application filed May 20, 1892. In an electric lamp socket and tap, the combination with a lamp-holding device of a pair of electrical contacts, a switch for closing the circuit between the contacts and external electrical connections mounted on the socket whereby an external translating device may be thrown in parallel or in series with the lamp.

490,607. Apparatus for Distributing Mail; Frederick D. A. Goold, New York. Application filed May 6, 1892. A movable carriage for distributing articles at several different delivery points and having several sub-divisions, these divisions being arranged in several columns side by side, means for retaining articles in the several subdivisions, and a magnetic releasing device for each of these means.

490,626. Railway Signal; Ira L. Green, Kittanning, Pa. Application filed Jan. 9, 1892. In a railway signal, a longitudinal lever pivoted at its rear end, the lever being located at the entrance to a block, means operated by a train entering the block for moving the lever rearward of a stand having an inclined surface engaging the beveled lug whereby the end of the lever will be raised simultaneously with the rearward movement of this lever, and means for locking it in its rearward position, means operated by the train passing out of the block for releasing the lever, and means for forcing it to its foremost position when released.



No. 490,630.—ELECTRIC CONDUIT.

490,630. Electric Conduit; Ernest Ransome, Oakland, Cal. Application filed April 5, 1892. A water conduit with passages for electric conductors formed in the walls thereof in combination with double entrance chambers, the one leading to the water conduit, and the other leading to the passages for electric conductors. (See illustration.)

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.